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ANALYSIS OF SURVEY DATA ON PHYSICIAN PRACTICE COSTS AND INCOMES

Final Report to the
Health Care Financing Administration

Vanderbilt University
Institute for Public Policy Studies
Health Policy Center
April 1981

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by

Vanderbilt University
Institute for Public Policy Studies
Health Policy Center

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Versions of several chapters of the report are published or may be published in the future. Chapter 9 was published in the Summer 1980 issue of Health Care Financing Review. Chapter 7 is awaiting publication in a HCFA conference proceedings. Chapters 3, 8, 11, 12, and 15 are currently being reviewed for publication. Pieces of chapters 2, 3, and 4 and chapter 6 will be submitted in the near future.

Our final thanks go to Jim Cantwell, our HCFA project officer, and (more generally) to the Office of Research, Demonstrations, and Statistics for its support during the course of our contract. Presentations and especially interpretations of information in the report are the responsibility of the authors and do not necessarily reflect the views of the Health Care Financing Administration or Vanderbilt University.

EXECUTIVE SUMMARY

In the mid-1970s, in response to a perceived need for more thorough data on physicians' practices than were available in the public domain, the Health Care Financing Administration (HCFA) initiated surveys of physicians' practice costs, incomes, and other practice characteristics. The surveys were conducted by the National Opinion Research Center (NORC) and monitored by HCFA's Office of Research, Demonstrations, and Statistics (ORDS). In 1978, HCFA let a series of contracts to analyze physician survey data collected in 1977 and 1978. This report presents research conducted under one of these contracts by Vanderbilt University, Institute for Public Policy Studies, Health Policy Center. Principal findings of the research are summarized below.

The analysis begins with an examination of the market for physicians' services and physician fee, income, and workload responses to changes in exogenous forces. Most of our findings in this area are consistent with past economic research on physicians. Our investigation includes more measures of individual physicians' characteristics than past research. In general, however, aside from higher visit fees and incomes of specialists (particularly surgeons), we find that very few physician credentials, including affiliation with a prestigious or "input-intensive" hospital, influence physician remuneration. Our major finding on the influence of practice structure is that, ceteris paribus, incorporated physicians tend to have higher fees, incomes, and workloads than unincorporated MDs. Because the reasons for this are unclear, incorporation is a topic worthy of further investigation in future research on physicians.

The empirical findings indicate that community affluence and health insurance continue to exert positive influences on fees and earnings. As the maximum amounts that private and public insurers will pay for specific procedures increase, physicians' fees and incomes tend to rise. Medicare and private health insurance (primarily Blue Shield and commercial insurance) tend to have similar positive influences but Medicaid, because it is by far the lowest paying major third party program, tends to have a restraining influence on physicians' fees and incomes.

Because medical school capacity has increased so dramatically in the past fifteen years, the effects of an expanding supply of physicians relative to population is of particular policy relevance. In contrast to some past research, we find that the specialty-specific physician-population ratio has negative effects on physicians' fees and incomes. These effects are not great, however, and it is clear that additions to the stock of physicians in the U. S. will result in increased expenditures on physicians' services, even if individual MDs' fees and incomes are depressed. The positive expenditure effect of an increasing physician supply should be more pronounced if the proportion of patient-care physicians who are graduates of foreign medical schools goes down.

Our descriptive analysis indicates substantial geographic and interspecialty variations in fees and incomes. We also find that physicians tend to defer a substantial proportion of their incomes into pension plans and other deferment programs--as much as fifteen percent, on average, in some specialties. Therefore, earnings statistics that exclude deferred income tend to underestimate physicians' incomes substantially. Incorporated MDs tend to have higher proportions of deferred income than their unincorporated colleagues.

Our analysis gives special attention to the malpractice insurance "crisis" because of the public visibility of this issue during the late 1970s. Several legislative actions were taken during this period to alleviate malpractice insurance price and availability problems at the state level. By the end of the decade the problem had abated, but it is not certain that the legislative remedies had much impact on the situation. Our analysis reveals very little in the way of market influences on malpractice premium levels. We do observe, however, that malpractice insurers do not risk discriminate very much, so that for high-risk practices malpractice insurance tends to be "a bargain." Physicians are responsive to price in their malpractice insurance purchases--as the price of a "standard" malpractice insurance package increases, physicians tend to purchase less.

Malpractice insurance premiums do not constitute a significant proportion of practice expenses even in relatively high-risk specialties. Nevertheless, the possiblity of "defensive medicine" effects of litigation threats expands the financial implications of this issue. We are unable to detect any systematic influences of malpractice insurance price variations on physicians' prescribing patterns, however. In general, we conclude that this issue has diminished in importance and is not worth much additional research attention in the 1980s.

Our analysis devotes considerable effort to uncovering effects of structural characteristics of health insurance programs--in this case, Blue Shield and Medicaid--on amounts physicians are paid for their services. We find that Blue Shield plan characteristics, in particular the degree of MD involvement in plan decision making, are the most powerful determinants of Blue Shield payment levels. This influence is especially evident for fees paid for services delivered by nonsurgical specialists. Aside from physician control of Blue Shield boards, community affluence is the most important exogenous influence on Blue Shield payment levels. Our results provide empirical support for antitrust inquiries into relationships between physicians and Blue Shield.

In many areas of the country physicians are given the option of participating in Blue Shield. In return for direct (guaranteed) payment from the Blue Shield plan, participating MDs agree to accept the plan's maximum reimbursements for specific procedures as payment-in-full. While this is a private sector program, it is ostensibly designed to improve access to physicians' services of low income Blue Shield subscribers. About three-fourths of physicians participate in Blue Shield when given the option. Where physicians control Blue Shield boards, this proportion increases; percapita income, however, has a negative influence on participation rates.

In general, as levels of maximum payments increase, participation in Blue Shield rises, but as patient ability to pay in the community increases, participation falls. These tendencies have also been shown by past research to hold for physician willingness to treat Medicaid patients. Our investigation of Medicaid payment levels indicates that as the federal matching share of the state Medicaid program increases, payments to physicians also increase. Federal sharing offsets, to some extent, the natural tendency for states to limit reimbursement in the face of low per capita incomes and/or high ratios of poor to non-poor populations. The findings indicate a slight tendency for state conservatism to be reflected by lower payments to physicians under Medicaid, but no such tendency is apparent with regard to racial composition of state populations.

Our empirical analysis devotes considerable attention to hospital-based physicians (HBPs), particularly radiologists and pathologists, and methods by which these physicians are compensated for their services. HBP specialties tend to be among the most lucrative in medicine, and monitoring expenditures on HBP services has proven to be a troublesome area to those concerned with health service expenditure inflation. HBPs receive compensation by salary, percentage of department revenue, fee-for-service, or some combination of these three basic methods. Trend data on HBP compensation methods reveal that the incidence of percentage compensation has fallen and fee-for-service compensation has become more popular since enactment of Medicare in the mid-1960s. We contend that Medicare's reimbursement principles and growth of health insurance for ambulatory health services have caused many HBPs to switch from percentage to fee-for-service compensation. Despite the fact that salaried HBPs earn considerably less than their colleagues who are compensated via one of the other two methods, a much larger proportion of HBPs is salaried than physicians in office-based specialties.

Our multivariate analysis of HBP incomes reveals that, for the most part, these physicians are subject to the same influences as office-based MDs. In contrast to some research on office-based MDs, however, HBP incomes tend to be relatively more sensitive to community affluence and less sensitive to insurance coverage distributions in the physician's market. Our analysis of HCFA-NORC data is not able to identify sources of much of the variation in HBP choice of compensation method. Other research indicates that this issue is more adequately investigated with the hospital rather than the physician as the unit of observation.

Our theoretical contributions to understanding the physicians' services market are developed in part to guide our empirical analyses and in part to stand alone. Two major findings emerge from the theoretical work. The first pertains to the notion that the physician's product may change as well as prices and quantitites in response to exogenous forces such as changes in physician supply relative to population. Product changes include waiting times for appointments and treatment, availability of the physician for telephone consultations, and other amenities which may not affect the probability of recovery from illness but are nevertheless of value to patients. We often refer to such factors as "quality-amenities" and find that the analytics of medical practice are enhanced when quality-amenities are regarded as a decision variable under control of the physician.

The other theoretical contribution pertains to the issue of physician demand creation, a topic that has interested (and confused!) both economists and policy makers for several years. Many analysts believe that physicians can and do expand demand for their services, often (it is alleged) to achieve a target income. This theory was inspired by the observation that fees (and sometimes incomes) often tend to respond positively to an increase in physician supply relative to population. Our theoretical analysis, however, indicates that if demand-inducing behavior is assumed, no inferences regarding an association between prices and any exogenous variable, including physician supply, can be drawn. Examination of product changes in response to changes in exogenous factors is likely to be far more fruitful and therefore worthy of investigation in future research on physicians.

SECTION I

INTRODUCTION AND OVERVIEW

Chapter 1

Introduction and Overview

Bruce Steinwald

CONTENT OF THE REPORT

This report has six sections containing fifteen chapters and eight appendices. Section I has one chapter, "Introduction and Overview," which summarizes conceptual considerations, major empirical findings, and implications of the research. Section II, "The Market for Physicians' Services," contains three chapters. It presents theoretical material and research findings on office-based physicians' fees, incomes, and workloads. Section III, "Physicians and Malpractice Insurance," contains two chapters which explore physician purchases of malpractice insurance and state responses to the malpractice insurance "crisis."

Section IV, "Third Party Payer Reimbursement Practices," focuses on the role of health insurance in medical practice. The two chapters in this section present evidence on relationships between physicians and Blue Shield and Medicaid, with emphasis on levels of third-party reimbursement for physicians' services. Section V, "Hospital-Based Physicians," considers the special characteristics of anesthesiologists, pathologists, and radiologists. The two chapters in this section present descriptive information on hospital-based physicians' practices and a multivariate analysis of practice performance measures. Section VI, "Models of Physician Behavior," contains five chapters that present theoretical information on physician behavior in the market for medical services.

Most of the individual chapters were prepared as separate research products and they are self-contained papers with their own policy and conceptual sections, empirical findings, and conclusions. Integration of these works occurs in Section I. The first part of the Introduction and Overview presents background information on issues, conceptual considerations, and specific research questions. The remaining parts summarize findings from Sections II through VI.

Issues

During the 1970s, public concern over inflation in health service expenditures was focused primarily on hospitals because of their large and increasing share of the health services dollar. While hospital cost increases have been truly alarming, this focus is somewhat misleading--not only do physicians' services constitute a significant proportion of all health expenditures, but physicians are the "gatekeepers" to nearly all forms of health-related purchases. Their decisions affect expenditures on hospital care, ambulatory health services, drugs and appliances, and many other forms of medical care. Moreover, it is the physician services market that is most closely associated with other public concerns for access, equity, and quality of health services. Thus, physician service expenditures per se vastly understate MD span of control in health care delivery and, by implication, an examination of factors that influence physician behavior and performance has ramifications that extend far beyond the market for physician services.

Medical education and physician supply constitute one vital area of policy affecting all aspects of the health services sector. In the mid-1960s there was a policy consensus that physicians were in short supply in the U.S. As a consequence of federal policies designed to encourage expansion of medical school capacity, additions to the stock of physicians have been substantial for several years. In 1976 Congress determined that physician supply increases were sufficient and the inflow of graduates of foreign medical schools was restricted. But, because U.S. medical schools have virtually doubled capacity during the past 15 years, the ratio of physicians to population is still growing in the U.S. Because of its prognosis for future trends in health service expenditures, this continuing trend is a source of alarm to many health policy analysts.

Implications of increased physician supply extend far beyond the simple responses in prices, hours of work, and other "traditional" economic responses. The increased supply of physicians also has implications for product composition, use of different types of health services, and other features of the health services network. Our analyses are confined to the physician services market but they include a variety of responses--fees, incomes, workloads, and service composition. Physician responses to aggregate MD supply, specialty composition, and country of origin, among other factors, are considered in our empirical estimates.

The proportion of expenditures for physicians' services paid by third parties has risen dramatically in the past 15 years, largely due to federal subsidies through the Medicare and Medicaid programs, but also due to expansion of private health insurance. While very few analysts or policymakers question the desirability of coverage, several issues are widely debated with regard to extent and nature of desirable copayment, provider incentives associated with different insurance programs, methods insurers use to determine maximum reimbursement amounts, among others. As health insurance has evolved in the U.S., so have the variety of different interactions between physicians and insurance programs and physician response patterns to insurance program characteristics. Our analyses include effects of all major types of health insurance on physician pricing and other behavior with emphasis on the interactions between physicians and two major programs--Blue Shield and Medicaid.

These two programs are particularly relevant to the matter of access of low income groups to physician services. Medicaid is designed for low income populations and its reimbursement criteria constrain amounts physicians may be reimbursed for their services. Some Blue Shield programs operate "service benefits" programs for low income subscribers that also constrain amounts physicians may collect. For these programs to enhance access to MD services, physicians must be willing to participate, and past research has established that this willingness is sensitive to the amount these programs will pay, among other factors. Our analysis focuses on participation and payment levels in these two health insurance programs.

Hospital based physicians (HBPs), as distinct from office-based physicians, provide ancillary medical services in hospital or clinic settings and generally do not maintain offices separate from the facilities where they work. HBPs have been the recipients of considerable policy attention in recent years for a number of reasons. First, expenditures for ancillary services have been increasing at a faster pace than health service expenditures generally, which places HBPs in the thick of debates over inflation in the health services sector. In addition, incomes of HBPs, particularly pathologists and radiologists, are among the highest in the medical profession. Finally, there are several structural characteristics of hospital-based medical practice (which may in part account for HBP income levels) that deservedly have elicited attention of policymakers. These include cross subsidization in hospital pricing structures, "exclusive dealing" arrangements between HBPs and hospitals, and methods of billing for HBP services and compensating HBPs. Our analysis includes an examination of trends in HBP compensation, current characteristics of HBP paractices, and evaluation of determinants of various aspects of the economic performance of HBP practices.

As indicated above, several themes run throughout our research on physicians. In general, we attempt to estimate the effects of a variety of external factors on different aspects of physician practice performance. Most of these external influences are "standard" economic variables that are widely investigated in a broad range of research analyses such as community income, factor prices, and others of this ilk. One item that has been accorded relatively little attention in the market for physician services, however, is government regulation and other forms of external control. At present, the hospital industry is much more heavily regulated than physician services but, beyond the role of government as a purchaser, there are other types of government incursions in the market for physician services that warrent research attention. Thus, in all phases of our research we attempt to assess the consequences of government involvement in the market for physicians' services.

Theory

It is now widely accepted that the standard economic model of competitive markets will not suffice when applied to health care. Such elements as asymmetric information and the agency relationship between providers and consumers, widespread insurance coverage, and difficulties in defining the medical care product, among others, are frequently identified as factors that reduce the validity of the competitive model. There is no consensus, however, on what is the appropriate model of the physician services market. While most analysts agree that monopolistic elements exist in this market, they differ on the degree of importance of these elements to provider and consumer behavior. Some analysts have suggested that physicians have power to induce demand for their services, often (it is suggested) in order to achieve a target income. But these interpretations are not without problems. If physicians can induce demand, what limits are there to inducement; and are there costs to the physician in engaging in this type of behavior? If the target income model is appropriate, how is the target established? Why should a target model be superior to "the sky's the limit?"

In the absence of a consensus model of physician behavior, we have developed alternative models and compared their respective predictions of responses to changes in such important exogenous variables as physician availability, input prices, and insurance coverage. Dependent variables examined are quantity, price, expenditures per capita, gross and net physician income, and "quality-amenities." This last factor (which may go by other labels) is a very important but often neglected aspect of medical services--it may encompass length of visit, waiting time, various creature comforts, availability of the MD for telephone consultations, and so forth. As defined, quality-amenities are not necessarily essential elements of treatment, nor are they frivolous, and they cost the physician expenses and/or time to provide. We find that the analytics of medical practice are greatly enhanced by including quality-amenities among physician decision variables, and evidence suggests that physicians do vary the level of quality-amenities provided.

Alternative models vary in accordance with assumptions about target income setting, demand inducement, and heterogenity of output. These models are presented in detail in Section VI. In many instances, the models generate similar predictions, but there are some differences as well. Our approach in the empirical analysis is to identify findings that tend to support or refute one model over another. In this way, the empirical work contributes to the conceptual foundation on which research on the physician services market is based.

Data

The principal data source for this study consists of Physicians' Practice Cost Surveys conducted during 1977 and 1978 by the National Opinion Research Center (NORC) under the sponsorship of the Health Care Financing Administration (HCFA). The surveys, administered by telephone to physicians and/or their office personnel throughout the U.S., obtained a comprehensive set of data on physicians' practices. These data include information on practice expenses, gross and net incomes, outputs, hours of work, input purchases, and usual fees. Also included are amounts of payments to physicians covered by specific third-party payers, amounts that each of these payers reimbursed the physician for specific procedures, and other data on characteristics of the physicians' practice.

NORC developed separate survey instruments for physicians in 15 office-based specialties and 3 hospital-based specialties. For the two instruments combined, the overall response rate was approximately 70 percent in 1977 and approximately 65.5 percent in 1978. Survey data files provided by NORC also contain information by which observations may be weighted to achieve a representative sample for the analysis. Biographic information derived from American

Medical Association data files were merged to the survey data file as were data on the counties and cities in which sample physicians reside. Additional supplemental information was merged to the files at Vanderbilt to achieve a complete data set for analysis of physician practice patterns. The individual chapters and the appendices contain information on the attributes and limitations of this data base.

Research Topics and Questions

Throughout our research we have attempted to formulate our empirical tests to yield information relevant to current policy deliberations regarding the physicians' services market. Many of the empirical issues and questions are summarized more thoroughly in Chapter 2, which also contains part of the theoretical foundation for our research. The empirical work presented in Section II assumes that the physician "firm" faces a stable demand curve, sets its prices, and controls practice inputs and outputs. We investigate the influence of factors external to the practice that affect both practice costs and the position of the firm's demand curve.

On the average, physicians' practice costs comprise about one-third of gross revenue. The most important practice expenses are payroll, office space, and malpractice insurance premiums. We investigate the influence of office employees' wages and other input prices on physicians' fees and other dimensions of practice performance. Our analysis devotes an entire section to malpractice insurance because of the relatively large amount of policy interest in this topic in the 1970s.

As of the late 1970s, health insurance paid for approximately two-thirds of physician service expenditures--roughly 60 percent from private insurance and 40 percent from public programs, primarily Medicare and Medicaid. Past research has demonstrated that health insurance has a substantial influence on physician practice patterns. Our empirical analysis includes assessments of the effects of insurer distributions and fee schedules. Because the major insurers tend to differ in the generosity of payments, different effects on physician behavior may be hypothesized. Fee schedules are maximum amounts insurers will pay for specified procedures. Not all insurance programs use fee schedules--some use "usual and customary" criteria to establish maximum payments. For purposes of analysis, however, we have converted all payment schemes into "fee-schedule equivalents" in order to assess the effects of payment levels on fees and on other aspects of physician firm behavior.

Among other demand factors, per capita income and physician availability are the most important. Because of the growth in private and public health insurance, it is reasonable to assume that the influence of patient income on physician practice behavior has diminished over time, but we include an assessment of this factor to determine whether income exerts an influence beyond the association between income and insurance. As stated earlier, medical school capacity in the U.S. has nearly doubled in the past 15 years. Our analysis includes an assessment of how growth in physician supply affects behavior of the physician firm.

The presence of Section IV and the level of detail of the analysis reflect our (widely shared) view that health insurance and the myriad of relationships, both arms-length and interpersonal, that exist between physicians and insurers are among the most important characteristics of the physicians' service market. Our research on Blue Shield and Medicaid does not consider effects of insurance on fees and other aspects of physician behavior--these topics are addressed in Section II. In Section IV we investigate determinants of levels of payments for physician services and in the case of Blue Shield, determinants of physician willingness to accept insurer reimbursement as payment in full.

The Blue Shield analysis emphasizes the role of physicians on Blue Shield boards of directors. In recent years, antitrust enforcement agencies have questioned whether such relationships present a conflict of interest and possible violation of antitrust statutes. These investigations have not established that physician representation on Blue Shield boards is illegal, but they have resulted in some constraints on the degree to which physicians can overtly control Blue Shield policies. Our empirical work is designed to test whether physician involvement in plan decisionmaking makes any difference to levels of payments to physicians or to physician willingness to accept such payments as full compensation for their services. Plan characteristics, product demand variables, supply variables, and individual MD characteristics are also evaluated in this research.

Since its inception in the mid 1960s, Medicaid has been a controversial program. Growth in Medicaid expenditures has exceded all projections, creating budget stress in both state and federal funding agencies. Critics of Medicaid frequently contend that two fundamental objectives, to enhance equity in delivery of services and to provide mainstream medical care to poorer segments of society, are not fully realized in practice. All analysts agree that physician acceptance of Medicaid is crucial to its success, and unwillingness of some physicians to accept Medicaid patients is seen as a tendency that reduces access to mainstream medical care. Past research has established conclusively that physician willingness to participate in Medicaid depends on payment levels and red tape involved in receiving payment. Our study investigates in detail the determinants of variations in payment levels.

Two program dimensions related to Medicaid payment levels are given particular emphasis. First is the method employed by states to establish payment limits--either fixed fee schedules or usual and customary charges. Second, states vary widely in the nature of governmental agencies that administer their Medicaid programs. These arrangments may reflect political attitudes toward the Medicaid program and its social welfare objectives, and they may be subject to varying degrees of influence by the medical profession. Our analysis seeks to shed some light on these dimensions of the Medicaid program.

Section V presents research findings on practice patterns of hospital-based physicians in the specialties of anesthesiology, pathology, and radiology. As noted above, HBPs have attracted considerable policy attention because of the growing contribution of ancillary service expenditures to hospital cost inflation and because of the financial and organizational characteristics of practice in these specialties. Our analysis emphasizes methods by which HBPs are compensated which fall into three basic types: salary, percentage of department revenue, and fee for service. Trends in pathology and radiology since the mid-1960s are examined and a scenario constructed to explain the forces that have shaped and altered HBP compensation arrangements over this period. The descriptive analysis also includes comparisons of incomes and other practice characteristics between HBPs and office-based MDs.

Our multivariate analysis of HBP practices has two parts. Initially, we estimate determinants of probabilities that HBPs will be compensated by each of the three basic compensation methods. These probability estimates are then entered as independent variables in equations to explain HBP income levels, expenses, and levels of output. This empirical work is guided by methodological approaches and specifications of past research on office-based physicians. Because of the high levels of incomes of HBPs relative to their office-based colleagues, and the policy interest that these income levels inspire, the multivariate analysis stresses identification of determinants of variations in HBP incomes.

Thus, the empirical work performed under our HCFA contract covers several policy issues and topics concerning the market for physician services. Major findings from this research are summarized in the remainder of the Introduction and Overview. Readers interested in detailed findings, findings from past research, empirical specifications, and estimation techniques are urged to consult the individual chapters and appendices.

THE MARKET FOR PHYSICIANS' SERVICES

Physicians' Fees

The analysis of office-based physicians' fees in Chapter 3 encompasses seven common medical and surgical procedures: follow-up office visit, follow-up hospital visit, proctoscope by internists, electrocardiogram by internists and cardiologists, gall bladder removal and single inguinal hernia repair by general surgeons, and diagnostic D and C by obstetrician-gynecologists. Only the two visit procedures apply to all 15 specialties represented in the HCFA-NORC surveys and dummy variables representing specialties are included in these fee regressions. Remaining independent variables, which enter all fee regressions, measure individual physician and practice characteristics, area product demand, and factor prices. As in all of the analysis in Section II, the individual physician is the observational unit. The following are the most significant findings from the fee analysis.

Compared to past research on physicians' fees, the analysis in Chapter 3 contains more measures of physician credentials to determine how the market values objective measures of physician "quality." In general, we find that very few of these variables influence fees--such factors as board certification, reputation of medical school, type of hospital affiliation, sex, and even foreign medical school origin have no consistent impact on fees. We do find, however, that specialists' visit fees tend to be higher than those of general practicioners (which probably reflects length of time in training) and incorporated MDs tend to charge more than unincorporated MDs for a variety of medical and surgical procedures.

The empirical results indicate that physicians with less than 10 years experience tend to charge at least as much as those with 10 to 35 years experience and more than the most experienced MDs. Although several explanations are plausible, we suspect that younger MDs may be more successful than older ones in dealing with third-party reimbursement programs, especially those that use "usual-customary-reasonable" (UCR) reimbursement systems. This interpretation is in line with our evidence and opinion (discussed in depth below) that, as in the market for hospital services, insurance characteristics in the physician services market are very important to fees and other aspects of MD behavior.

Among area product demand variables, both real per capita income and population density have positive, statistically significant impacts on fees, findings that are consistent with past fee research. The effect of physician availability, as measured by county physician-to-population ratios (confined to specialties represented in the individual fee regressions), is uniformly negative but not large. The physician availability measures were specified so as to minimize biases due to simultaneous influences and border-crossing. The consistent negative effect of physician availability on fees stands in contrast to some past research which indicates a positive association, leading some analysts to favor the target income theory of physician pricing behavior. Nevertheless, physician availability elasticities are relatively low in the fee regressions, never exceeding -0.2, which indicates that increasing physician supply is unlikely to have much salutary impact on fee inflation. These results are consistent with standard models of firm behavior in imperfectly competitive or monopolistic markets.

The empirical analysis of fees devotes more attention to public and private health insurance than to any other class of explanatory variable. Taken as a whole, the insurance variable coefficients clearly establish a link between health insurance and physicians' fees. According to the HCFA-NORC surveys, about 91 percent of the U.S. population visiting office-based doctors has some type of coverage. The regression results imply that if mean fee schedules rose by $1.00, mean fees would rise by $0.22 to $0.35. Fee schedule elasticities, evaluated at the means of dependent and other independent variables, vary from 0.13 for follow-up office visits to 0.29 for gall bladder removal. These results are consistent both with standard economic theory and with policymakers' perceptions about the functioning of the physicians' services market.

The analysis of third-party reimbursement also contrasts effects of different types of health insurance on usual fees. Parameter estimates from the fee regressions indicate that as the proportion of patients with private (Blue Shield or commercial) health insurance increases, so does the physician's usual fee. The proportion of Medicare patients also has a positive effect on fees, relative to the effect of no insurance, but the effect of Medicaid coverage is consistently negative. Results on the Medicaid variables indicate that mean fees of physicians who participate in the Medicaid program are consistently below fees charged by physicians who do not participate, and for participants mean fees are positively influenced by the generosity of Medicaid fee schedules. In response to recent budget crises, some states have reduced Medicaid fee schedules (or not allowed them to rise), which may have an adverse effect on access to services but also an inhibiting effect of fee inflation.

Three variables represent factor prices of physicians' practice inputs in the fee regressions--mean wage rates of hospital employees, office rental costs, and malpractice insurance premiums. All three variables are uniformly positive and usually statistically significant at conventional levels. Because hospitals tend to be the dominant employers of nurses and other non-physicians with medical training in a community, the hospital wage may be viewed as representing the labor factor price faced by the physician firm. Hospital wage elasticities are about 0.15 in the visit fee regressions but range from much lower than this to much higher in the other procedure fee regressions.

Hospital wages have not increased sufficiently in recent years to be a major cause of physician fee inflation. The office rent variable is not particularly well-measured and yields somewhat inconsistent positive effects on fees. The malpractice premium results, however, are more interesting. In the visit fee regressions, the elasticity of this variable is around 0.10, and elasticities range from 0 to 0.17 in other procedure regressions. This effect is important given the dramatic growth in malpractice premiums during the 1970s. Combining all three factors, price variables yield total elasticities in the 0.1 to 0.2 range. Like institutional health care providers, physicians often cite factor prices as a major cause underlying fee increases. The empirical results indicate that input prices are one of several influences on fees rather than a dominant force.

length of visit results

One issue in the fee analysis is to what extent do factors associated with fees also influence the nature of medical care supplied. If such potential influences are not considered, there is a substantial risk of drawing improper inferences from the fee analysis because of product changes that occur in conjunction with fee responses. It is very difficult to hold product constant in analysis of medical care, however, because suitable product measures are not readily available. Referring back to the conceptual discussion above, it is appropriate to view product variations in terms of quality-amenities of physician visits and other aspects of patient-physician relationships. This section briefly reviews influences of essentially the same group of independent variables as specified in the fee regressions on length of hospital and office visits. These visit lengths may be viewed as indicators of quality-amenity levels in medical practice.

In terms of physician credentials and other individual and practice characteristics, the most substantial influence on visit length is physician specialty. In general, hospital visits tend to be relatively short for surgical specialists and relatively long for specialties which are not hospital-intensive, such as allergy and dermatology. These results tend to narrow the quality-adjusted fee differences by specialty suggested by the fee regressions. Foreign medical school graduates from third-world countries tend to have longer visit lengths which, in part, account for the finding of essentially no difference between their fees and those of U.S. medical school graduates.

Relatively high fees of younger doctors cannot be explained on the basis of variations in length of visit. Moreover, incorporated MDs tend to have both shorter visit times and higher fees, ceteris paribus, than unincorporated MDs. These results could reflect both efficiency differences and/or variations in styles of care; but we must admit that the precise effect of incorporation is not clearly suggested by either conceptual or empirical considerations. Finally, holding other factors constant, female MDs have higher visit lengths than male MDs, even though sex has no appreciable effect on fees.

Among the product demand variables, both the physician-to-population ratio and the fee schedule variable have positive signs, although neither is consistently statistically significant or large in terms of elasticities. These results provide weak support for past evidence and theory that increases in physician supply and levels of insurance coverage create incentives for physicians to upgrade quality-amenity levels. Associations between product demand variables, especially insurance, and the nature of physicians' outputs are dimly understood at present, and findings from this analysis contribute only a slight amount to this understanding. Because product responses to changes in exogenous variables are both important in their own right and have a potentially great effect on interpretation of related research findings on prices and output quantities, additional research employing more thorough and accurate measures of product content deserves a high priority.

Physicians Incomes and Workloads

In Chapter 4 we present our analysis of office-based physicians' gross and net incomes and workloads measured by number of patient visits. The specification of explanatory variables is similar to the fee analysis with a few exceptions, and the dependent variables and some independent variables are in log form following established conventions in economic analysis of incomes. The empirical work consists of both descriptive and multivariate statistics.

Data available from the HCFA-NORC surveys provide estimates of both current and deferred income. Exclusion of the latter, which is unavailable in some physician data sources, creates serious underestimates of total net income. Descriptive information indicates that incomes of incorporated MDs tends to be higher than that of unincorporated MDs, and income tends to rise with practice size (number of MDs). Comparisons of income figures from the HCFA-NORC surveys and comparable data compiled by the American Medical Association (AMA) and Medical Economics, Inc. show no major discrepancies. For both 1976 and 1977, differences between HCFA-NORC physician net incomes and those computed from the other two sources never exceed four percent. The implied reliability of the HCFA-NORC income data increases confidence that may be placed on the empirical analysis of income determinants.

The analysis of solo physicians' incomes includes numerous measures of physician credentials and other individual characteristics. These estimates indicate that, with the exception of allergists, gross and net incomes of surgical specialists tend to be higher than those of nonsurgical MDs. Holding other factors constant, general-family practitioners, internists, and pediatricians tend to be relatively low income earners--particularly the latter specialty in terms of net income per hour.

The results on other individual and professional characteristics variables are very similar. First, foreign medical school graduates' incomes tend to be lower, on average, than those of U.S. medical school graduates, but there is no income premium for graduation from a "distinguished" U.S. medical school. Second, the experience-earnings income curve is flat for gross income and has a shallow inverted U-shape (the expected pattern) for net income. As in the case of fees, younger physicians do not seem to require much (if any) start-up time to build revenue-production at maximum levels. Fourth, also consistant with the fee analysis, there is a strong association between incorporation and income levels which cannot be explained solely in terms of income deferment or any other observed tangible differences between incorporated and unincorporated practice. Fifth, sex and participation in prepaid group practice (PGP) have no measured impact on gross incomes, but female MDs and PGP participants earn less net income than male fee-for-service only MDs, as do salaried MDs. Last, being affiliated with a prestigious or input-intensive hospital is not a source of high earnings. Average cost per adjusted patient day of the physician's primary hospital has no impact on gross income and a statistically significant but relatively small (elasticity $\simeq$ 0.10) positive effect on net income.

All product demand variables have a statistically significant effect on physicians' incomes and these effects are roughly equivalent in the gross and net income regressions, suggesting that the demand influences are primarily manifested in the physician's implied hourly wage rather than in level of effort. Per capita income has the most pronounced effect, with elasticities as high as 0.46 in the total net income (current plus deferred) regression. Even with insurance effects held constant, patient ability to pay has a substantial effect on both fees and earnings. The effect of insurance on incomes is similar to that on fees. As the percentages of patients with private health insurance and Medicare increase, so do physicians' incomes, although elasticities are not nearly as large as that of per capita income. As with fees, the effect of the Medicaid proportion on income is negative--the level of this effect, however, is sensitive to the method of specifying the Medicaid variable.

The effect of physician availability in the market area on individual MD incomes is negative, as expected, and associated elasticities are on the order of

-0.10. This result is very robust--the elasticity remains at this level when different forms of the MD availability measure are used and in the different income regressions. It is possible, however, that the elasticity is underestimated due to collinearity with other included variables (particularly population density) and especially due to unaccounted for patient border-crossing that may occur in response to differential MD availability in contiguous areas. Our empirical analysis has addressed this problem to a greater extent than most past research in this area but it cannot be totally dismissed.

Finally, the three factor price variables which measure labor, office rental, and malpractice costs faced by the physician firm, in combination, yield elasticities that are positive in the gross income regressions (suggesting that input cost increases are shifted forward to consumers to some degree) but small in absolute value. Both gross and net physicians' incomes appear to be relatively insensitive to real (corrected for cost of living) changes in prices of labor and non-labor inputs.

total visits results

Visits are extremely heterogenous measures of physician practice output and they exclude certain important types of outputs altogether (for example, surgical operations and diagnostic tests). Nevertheless, it is useful to examine effects of exogenous variables on visit volume both because physician levels of effort merit attention in their own right and because such information provides an important supplement to findings on fee and income determinants. The empirical analysis homogenizes visits to the extent possible by weighting visits by their respective mean lengths in minutes. Operations and assists are also weighted and included in the visit measure.

The visits regressions help to explain the higher incomes of incorporated MDs--they tend to have substantially more visits per unit of time than unincorporated MDs. Workloads of physicians affiliated with teaching hospitals and costly hospitals tend to be lower, on average, than those in the reference categories. Neither of these hospital variables has much impact on incomes, but the visit results imply a higher level of effort-adjusted income for physicians who work in teaching and expensive hospitals.

The effect of per capita income on visits is positive but not significant and the effect of the physician-to-population ratio is negative and statistically significant but the degree of effect is slight. It appears that physician availability has very little effect on workload. Private health insurance, Medicare, and Medicaid all have substantial positive effects on visits relative to the reference category of uninsured patients. The combined results of the effects of insurance on incomes and workloads imply that all of the income differential due to insurance coverage could be accounted for by the workload effects, with no effect on fees. This implication is contradicted, however, by the direct evidence of positive insurance effects on fees reported earlier and in Chapter 3.

PHYSICIANS AND MALPRACTICE INSURANCE

Physician Demand for Malpractice Insurance

Malpractice litigation and insurance have been accorded considerable attention in recent years because of the vast increases in lawsuits and premiums that physicians have to pay to maintain coverage. Physicians cannot completely insure against the losses of litigation because some monetary and certainly all emotional risks are uninsurable. Thus, the physician can only attempt to protect himself against these risks by professional behavior that reduces the probability of being sued. These behaviors include relocation in low malpractice threat areas, providing extra care to patients (defensive medicine), altering the composition of services (for example, by providing less or no surgery), and avoiding settings for care where the risk of being sued is high. Most of the direct financial risk of malpractice litigation is insurable, however, and the physician must decide how much insurance to buy, given its price--the topic of Chapter 5.

Four factors determine the demand for malpractice insurance: its price, the risk of being sued and associated financial loss, physician attitude toward risk, and the cost of self-protection. Like all insurance, malpractice premiums are not actuarially fair because some fraction of the premium pays for administration and insurer profit. Insurers have had difficulty in projecting malpractice claim frequencies and amounts partly because of the lengthy lag between time of service and time of litigation during periods when claims experience has been volatile. Insurers engage in very little risk discrimination--they tend to recognize physician specialty and surgical/nonsurgical distinctions in premium setting but very little else. However, the correlation between premiums and various measures of malpractice activity is very low and there is likely to be a substantial discrepancy between what physicians pay in premiums and the expectation of malpractice insurance benefits.

Applying economic theory to the market for malpractice insurance is difficult because of the presence of uninsurable risks and the option of self protection. Insurance and self-protection can be either substitutes or complements. Nevertheless, the Schlesinger paper (Chapter 15) provides some detailed theorizing on the demand for malpractice insurance. Empirical estimation of the demand for malpractice insurance is also difficult because precise measures of risk aversion, risk reduction activities, and insurance price (relative to expected payout) are unavailable. The estimates contained in Chapter 5, however, provide some clues as to the functioning of the market for medical malpractice insurance.

The dependent variable in the malpractice premium analysis is the ratio of the actual premium paid to a premium for a "standardized" (by specialty and state) policy--this is a reasonable proxy for the amount of insurance purchased, but because of imprecision in the premium and liability limit data, the dependent variable was partitioned into three ordinal groups representing low, middle, and high purchases of malpractice insurance. Also because of data limitations, the analysis is confined to solo practitioners for 1978 only. Multiple logit analysis is used to estimate determinants of variations in the extent of insurance purchased.

The empirical results indicate, as expected, that surgical specialists tend to purchase more malpractice insurance than generalists and nonsurgical specialists. In contrast to much of the analysis in Section II, other professional and personal characteristics of physicians do not have an impact on the dependent variable. An exception is incorporation--incorporated MDs purchase more malpractice insurance than their unincorporated colleagues. This is consistent with evidence presented in Chapter 4 that incorporated MDs tend to have relatively large workloads. The nature of the hospital of the physician's primary affiliation has no significant impact on malpractice insurance purchases, except that physicians with no primary affiliation tend to purchase relatively little. This is consistent with descriptive evidence that hospital-intensive practices tend to incur higher risks of malpractice litigation.

Among the product demand variables, physician availability has a negative impact and per capita income and insurance generally have a positive impact on malpractice insurance purchases. These results are also consistent with the workload findings--in general, factors that tend to have a positive effect on workload also have a positive effect on amount of malpractice insurance purchased.

The most robust empirical finding is that physicians are indeed responsive to price variations in their malpractice insurance purchases. As price rises, they purchase less, and vice-versa. The lack of detailed risk discrimination by insurers makes malpractice insurance a very attractive purchase for physicians in relatively risky practices. These purchases are subsidized to some extent by less risky MDs whose malpractice insurance purchases tend to be relatively low. Thus, one may conclude from this analysis that physicians are rational purchasers of malpractice insurance and the market, despite its quirks, functions in a normal (if not very efficient) fashion.

State Responses to the Malpractice Crisis

The medical malpractice crisis of the mid-1970s involved both a dramatic increase in premiums and a reluctance of many companies to write malpractice insurance policies. There had been and continued to be extreme variability in malpractice premiums, even within the same medical specalties. For example, the premiums paid by orthopedic surgeons in 1974, on average, were more than seventeen times greater in New York State than in North Carolina. The malpractice situation was viewed by the public as a source of medical cost inflation and of reductions in access to needed services by some segments of the population. During the late 1970s nearly all states took some legislative action to alleviate malpractice insurance price and availability problems. Legislative responses were of three types: tort law modification, alternatives to trial, and insurance provisions. By the end of the decade malpractice insurance problems had abated but it is not clear that the legislative remedies had much impact on the situation.

Our empirical research on malpractice insurance premiums examines premium levels and changes over the 1974 to 1978 period. Premiums paid by general practitioners, ophthalmologists, and orthopedic surgeons were entered as dependent variables. During the study period, real malpractice premiums (deflated by a cost-of-living index) peaked in 1976 and declined thereafter. The empirical specification included measures of legislative changes, per capita income, extent of surgery, and supply of lawyers and physicians as explanatory variables.

Results of the empirical investigation were disappointing. None of the independent variables was shown to be a consistent determinant of malpractice premium levels or changes. These results serve to illustrate how little we know about how prices and quantities of this important input into the practice of medicine are determined. There is a need for more "hard" evidence on how malpractice insurers really set premiums.

PHYSICIANS AND HEALTH INSURANCE - BLUE SHIELD AND MEDICAID

Very few analysts would quarrel with the view that health insurance is one of the dominant forces shaping physician behavior and practice performance. Early research on physicians frequently measured insurance in terms of proportions of populations having some degree of coverage. More recently it has become widely accepted that health insurance programs differ from one another in ways that have important implications for the functioning of the physicians' services market. Among the most important health insurance program characteristics are the maximum payment levels that plans establish for compensating physicians who provide covered services to plan subscribers. These payment limits affect physician income streams, patient out-of-pocket expenditures, and degree of availability of physician services to different subscriber groups. Insurance programs have been used as a device to increase access to physicians' services of low income populations. This is accomplished not only through the major public subsidy programs, Medicare and Medicaid, but also (to a lesser extent) through the major private program, Blue Shield. Past research on these programs has established that the degree of their success in improving access depends, in part, on levels of payments to physicians.

Research presented in Section IV investigates determinants of payment levels for physicians' services under Blue Shield and Medicaid. Chapter 7 focuses on the role of physician involvement in the Blue Shield decision-making process as a factor of potential importance to the levels at which maximum payments are set. A second part of Chapter 7 investigates the contribution of payment levels and other factors to physician willingness to participate in Blue Shield's "service benefits" programs which are ostensibly designed to increase availability of services to low income groups in the private sector. Chapter 8 investigates variations in amounts state Medicaid programs pay physicians for services delivered to Medicaid eligibles. The analysis focuses on the income redistribution and bureaucratic features of the Medicaid program to relate program performance to accomplishment of social welfare objectives. Because physician participation in Medicaid has been thoroughly researched in the past, this topic is not included, although liberal references to this past research are made throughout Chapter 8.

This discussion begins with background information on the two research topics and descriptions of data and specification. Three sections on research findings are then followed by a concluding discussion of policy implications.

Background

Our research on Blue Shield payments for physicians' services is conducted in a policy context that presently views the historical connection between Blue Shield plans and organized medical groups with some skepticism. In particular, such activities as physician participation on Blue Shield boards, organized medicine's role in Blue Shield board selection, and other indications of a physician-Blue Shield nexus have been cited as grounds for antitrust investigations by both legislative and judicial branches of government in the late 1970s. Unfortunately, such evidence is structure-process oriented and the more meaningful outcome-oriented evidence has generally been lacking in antitrust inquiries into medical markets.

The research presented in Section IV attempts to gauge some of the consequences of organized medicine's relationships with Blue Shield programs. In particular, we are concerned with the effects of physician control on payments to physicians for treatment of Blue Shield subscribers, and on willingness of physicians to participate in Blue Shield service benefits programs. Physician participation is similar in concept to acceptance of Medicaid patients and to assignment of benefits under the Medicare program. Blue Shield participation means that, under certain circumstances which vary from plan to plan (but normally are directed toward low-income subscribers), the physician agrees to accept the plan's reimbursement for services as payment in full. In return for participation, the physician is paid directly by the plan, in contrast to non-participating physicians who are not constrained by the plan in what they charge patients but must collect their fees from patients, thereby incurring higher bad debts and collection costs.

Given that increasing government intervention into physician-Blue Shield relationships (which in itself generates significant expenditures) seems likely, there is a clear need for evidence on the effects of physician involvement in Blue Shield activities. Many observers have pointed to the desirability of health insurers, as purchasers of health care services, acting as a more competitive influence in health care markets, and much public activity in this sphere is directed toward fostering competition. Yet, in the absence of evidence on how relationships between health care providers and insurers affect market performance, such policy actions are based largely on faith rather than sound reasons to expect performance to improve. This research represents an initial attempt to provide the type of evidence that should be the foundation of antitrust and related activities in medical markets.

Relationships between organized medicine and Blue Shield span many years; indeed, medical societies were instrumental in organizing the first Blue Shield plans. Because of this historical association, Blue Shield is widely known as the "doctors' plan," but, in fact, there is wide interplan variation among the 69 Blue Shield plans in the U.S. in the degree of physician involvement in plan activities. Agreements by physicians to participate in Blue Shield service benefit programs can be made by individual physician decision or by collective decision by the state or local medical society on behalf of its members. Individual agreements are about three times as numerous as blanket medical society endorsements. However, when given the option of participating, recent evidence indicates that approximately 28 percent of office-based MDs decline.

The fact that a significant proportion of MDs opt out of Blue Shield's service benefits programs indicates that there is a limit to the concept of Blue Shield as the doctors' health insurance plan. Indeed, there are a number of plausible ways that one could formally depcit relationships between Blue Cross and physicians which have varying implications for prices charged, quantities of services offered to service benefits and non-service benefits patients, and maximum amounts plans will pay for services rendered to Blue Shield subscribers. In general, however, all alternative models of physician-Blue Shield behavior lead to the prediction that greater Blue Shield control by doctors should cause higher Blue Shield payments for services and higher participation rates. The empirical work in Chapter 7 is designed to test these hypotheses.

Since its inception in the mid-1960s, Title XIX of the Social Security Amendments of 1965, known as Medicaid, has come under attack from a number of directions. From 1970 to 1977, Medicaid expenditures grew, on average, at a compound rate of 15.2 percent per annum, and many states have found these expenditures to be excessively burdensome. At the same time, some critics have noted that the principles of equity and provision of "mainstream" medical care to poorer segments of the population, two of the fundamental social goals of Medicaid, have not always been realized in practice. In particular, because states determine eligibility and benefits within federally established limits, there is wide interstate variation in the degree social welfare subsidies implemented through the Medicaid program. Moreover, Medicaid has often been criticized on the grounds that recipients tend not to receive mainstream medical care but something lower in quality than services available to those with private health insurance coverage.

Physicians, as the "gatekeepers" to medical care, are appropriately viewed as crucial to the success of Medicaid in accomplishing its access and equity objectives. Past research has established conclusively that physician willingness to participate in Medicaid is contingent upon Medicaid payment levels and bureaucratic "hassles" involved in treating Medicaid patients. Chapter 8 examines the first of these factors, variation in payment levels for specific medical services.

In attempting to discover why Medicaid payments to physicians for specific services vary, two conceptual approaches are followed. The first treats income redistribution and in-kind public assistance as public goods whose distribution is under the collective control of voters/taxpayers. A second view is that Medicaid payments are largely determined by interactions between government agencies, fiscal intermediaries, and physicians, without necessarily reflecting the preferences of voter/taxpayers or their representatives. Our research yields evidence that, to some extent, Medicaid payments to physicians are indeed linked to collective social welfare preferences of state populations.

States have considerable latitude in designing their Medicaid programs. However, in all states (except for Arizona which does not participate in Medicaid) payments for services rendered are made directly to providers who must accept the Medicaid reimbursement level as payment in full. Providers are free to refuse to treat Medicaid patients, and many physicians do opt out of the program. Medicaid is jointly financed by federal and state governments with the poorer states (based on state per capita income) receiving the largest share of federal financing. The federal proportion ranges from 50 percent in the more affluent states to as high as 78 percent in the poorest state (Mississippi).

For purposes of this study, two program dimensions determined at the state level are particularly relevant. First, states select the methods used to determine reimbursement levels for services rendered by physicians, so long as resulting payments are "reasonably" related to costs of care and do not exceed limits of reimbursement for specific procedures established under the Medicare program. Medicare thus establishes the upper bound for payments under Medicaid, and many states have adopted the Medicare method of reimbursement which relies on physicians' "usual and customary" charges. Second, Medicaid programs may be administered by different types of state agencies which are hypothesized to be subject to political pressures from organized medicine to varying degrees. An objective of our research is to determine whether Medicaid payments by physicians are influenced by reimbursement methods or nature of the agency administering the program.

Data and Specification

As in all phases of research described in this report, the data base is the HCFA surveys of physicians conducted by telephone and personal interview by the National Opinion Research Center. Research reported in Section IV is based on the 1975-76 survey of office-based MDs in the fields of general and family practice, general surgery, internal medicine, obstetrics-gynecology, and pediatrics. The overall response rate was 68 percent. The usable response sample consists of 2,024 physician interview observations in a cluster of states corresponding to 27 of the 69 Blue Shield plans in the U.S. and to 25 state Medicaid programs. Additional physician data from American Medical Association biographic files, plus area data corresponding to the states, counties, and Blue Shield plans where physician respondents reside, were merged to the interview data to form the complete file for analysis. Blue Shield plan data relating to physician control were obtained from the Federal Trade Commission.

The dependent variables consist of Blue Shield and Medicaid payments for several specific medical services (data obtained from MD respondents) and a binary variable indicating respondent participation in Blue Shield. Explanatory variables in the Blue Shield analyses consist of (1) characteristics of Blue Shield plans, including those indicative of physician control; (2) variables related to consumer demand for service benefits (that is, paid in full) insurance coverage; (3) variables related to determinants of the physician supply curve facing Blue Shield; (4) and variables describing individual physician characteristics. The Blue Shield and Medicaid payment regressions were estimated via OLS. Probit, which is an appropriate estimator for binary dependent variables, was used for the Blue Shield participation regressions.

Explanatory variables in the Medicaid payment analysis fall into five categories: (1) variables related to the "price" of Medicaid to the voter/taxpayer, that is, the extent of transfers effected through the Medicaid program; (2) variables related to the nonpoor's demand for in-kind transfers to the poor; (3) variables related to the supply of physicians' services facing the state Medicaid agency; (4) structural characteristics of the Medicaid program; and (5) individual physician characteristics. Except for the fifth category and one variable (an area wage index pertaining to nonphysician employees) in the third category, all explanatory variables are defined for the physician's state.

Empirical Findings - Blue Shield Payment Levels

Regressions corresponding to Blue Shield payment for six procedures were estimated: follow-up hospital visit, follow-up office visit, inguinal hernia repair, diagnostic D and C, complete blood count, and electro-cardiogram. Because not all physicians in the sample perform all procedures, the degrees of freedom in the regressions are far below the total number of sample MDs; observations range from 235 in the hernia repair regression to 876 in the follow-up hospital visit regression. The R^2s range from 0.15 in the follow-up hospital visit regression to 0.31 in the follow-up office visit regression. In terms of statistical significance, the most powerful determinants of variations in Blue Shield payments were the Blue Shield plan characteristics variables.

The 29 Blue Shield plans were classified into four groups with respect to physician control of board appointments. The empirical results showed that, compared to plans where no control was apparent, plans where 51 percent or more of board members were medical society appointed tended to have higher payments for the procedures studied. (It should be noted that physician appointment control and physician membership on Blue Shield boards are positively and highly correlated.) The differences were 15 and 28 percent for the two visit variables, 17 and 13 percent for the two diagnostic test variables, and 4 and 9 percent for the two surgical procedures. The coefficient of the physician control variable was statistically significant at the 5 percent level in four of the six regressions. These findings suggest both that physician control of Blue Shield boards does tend to exert a positive influence on payment levels, but that this influence is not consistent across specialties. In particular, surgeons tend to benefit less from physician control than non-surgeons.

A variable indicating physician appointment of less than 50 percent of Blue Shield board members also had positive, but smaller, impacts on payment levels. The positive impacts on office and hospital visit payments averaged about 12 percent. A fourth category of Blue Shield boards consists of those designated as self-perpetuating, which may or may not be subject to medical society influence. Signs on this variable displayed no consistent pattern. Moreover, this was a very small category (9 percent of respondents) compared to the larger and most policy-relevant category of plans where a majority of board members were medical society selected (54 percent of respondents).

Another dimension of physician control of Blue Shield pertains to control of key committees of the board. Of five key committees identified, a majority of members were physicians in all five committees in 65 percent of sample cases. When entered as a binary variable indicating control of all five committees, the coefficient was positive in five of the six regressions and statistically significant in three. A final variable indicating formal medical society approval of the Blue Shield plans also tended to exert a positive impact on payment levels, but these results were neither uniform nor particularly strong, as gauged by statistical significance.

Of all variables representing exogenous influences on demand for paid-in-full insurance coverage, which include per capita income, extent of unionization in the area, and extent of agricultural employment, only per capita income was an important determinant of payment levels. Parameter estimates pertaining to per capita income were positive and statistically significant in five of the six payment regressions, and associated elasticities were quite high, ranging from 0.24 to 0.57. The factor supply variables, including an area office employee wage variable, tended not to have consistent impacts on Blue Shield payment levels.

In general, variables representing physician characteristics had anticipated effects on payment levels. Ceteris paribus, physicians with higher credentials (that is, specialty training and/or board certification) tend to be paid more, while older physicians and those with foreign training tend to be paid less.

Empirical Findings - Physician Participation in Blue Shield

Two probit regressions were estimated on the binary physician participation dependent variable: one with all available observations included and one corresponding to physicians from Eastern and Southeastern U.S. only. The latter regression included more explanatory variables, but since the two regressions yielded the same qualitative findings with respect to policy-relevant variables, they are discussed collectively below.

As in the case of the payment level regressions, the physician control of Blue Shield variables were consistently important determinants of physician participation in Blue Shield. Physicians practicing in areas where medical societies make appointments to Blue Shield boards are more likely to participate.

Unexpectedly, the estimated marginal impacts on participation were higher, compared to no control observations, in areas where less than 50 percent of board members are appointed than in areas where more than 50 percent are appointed. The corresponding probability (of participation) differences are 0.20 and 0.14, respectively. While this result is surprising, it does not detract from the overall conclusion that physician control of Blue Shield board appointment positively affects participation rates.

Results on the remaining Blue Shield control variables are a bit difficult to interpret. For example, the coefficients of the variable indicating self-perpetuating Blue Shield boards (a relatively rare occurrence) were positive and larger than the board-appointment coefficients. In contrast, the coefficient of the variable indicating physician control of all five key Blue Shield committees was negative with small implied marginal effects. These results contrast somewhat with the results on Blue Shield payment levels. However, the positive coefficient on the variable indicating blanket medical society endorsement of Blue Shield, which implies 1 to 2 percent higher participation rates on average, is consistent with the result of a positive (but small) effect of medical society endorsement on payment levels.

As in past research on physician participation in Blue Shield, higher per capita income in the physician's area of residence is a substantial deterrent to participation. Physicians can command higher fees from non-service-benefits patients in high income areas and are therefore less likely to participate, ceteris paribus. Similarly, the evidence indicates that higher area wages of non-physician personnel are not always reflected in higher Blue Shield payments, and in areas where such wage rates are relatively high, physicians are less likely to participate in Blue Shield.

Remaining marginal impacts on participation are quite small. The largest, in absolute value, is the negative effect of medical school faculty affiliation on participation. Of all physician personal and professional characteristics, this characteristic had the greatest impact.

Empirical Findings - Medicaid Payment Levels

Dependent variables in the Medicaid analysis pertain to payments for a selection of procedures performed by office-based physicians: follow-up hospital visit, follow-up office visit, inguinal hernia repair, diagnostic D and C, complete blood count, and electrocradiogram. The dependent variables are expressed in two ways: first, the Medicaid payment to the physician for each of the above procedures relevant to the practice; second, the ratio of the Medicaid payment to the physician's usual charge for specific procedures. A total of sixteen regressions were estimated with as many as 22 independent variables. R^2s ranged from 0.23 to 0.55, and degrees of freedom from 175 to 853. To conserve space, only general tendencies and variables that had the greatest impact on Medicaid payments and/or ratios of Medicaid payments to usual fees are discussed.

Our theoretical work, not discussed above, yielded the prediction that as the "price" of Medicaid to state voter/taxpayers rises, payments to physicians should decline. Consequently, it was expected that in states where the federal share of Medicaid expenditures is high, payments should also be high, and vice-versa. This prediction was borne out in that the sign of this variable was positive in 11 our of 12 regressions where it was included. The effect of the federal matching share was especially evident in the ratio regressions where elasticities ranged from 1.50 (complete blood count) to 2.78 (inguinal hernia repair). Similarly, in states where the ratio of poor to nonpoor population is high, it was predicted that payments would be relatively low. This prediction was generally supported, particularly in the ratio regressions where elasticities were as high (in absolute value) as -0.70 (diagnostic D and C).

Of the demand-shift variables, only per capita income had a consistent impact on Medicaid payment levels or ratios. Estimated coefficients were positive in 5 of 6 level regressions and in all of 6 ratio regressions, where all associated elasticities exceeded 1.0 and some exceeded 2.0. Coefficients of variables indicating the percent of state population voting for the Republican presidential candidate in 1972 (a state measure of political conservatism), percentage of persons who are black, and percentage of persons living in metropolitan areas tended to be much less precise and vary in sign.

Of the supply-shift variables, the effects of the wage rate variable (an index of wages of non-physician personnel, which is intended to capture variations in a large component of physicians' office expenses) were strongest. The positive effect of the wage variable on surgical procedure payments was relatively small, but the estimated impact on the follow-up hospital visit payment was large, with an associated elasticity of 0.74. Medicaid reimbursement levels are generally lower in states with high proportions of general practitioners and female physicians, but no consistent patterns are evident on variables measuring physicians per 1000 population in the state or proportion of state physicians who are graduates of foreign medical schools.

In terms of Medicaid program structural characteristics, two results are noteworthy. First, physicians tend to be paid a lower proportion of usual fees when the program is run by the state health department, possibly reflecting an orientation toward institutional health services in such departments. Second, we had hypothesized that where the Medicaid program uses the Medicare "usual and customary" method of reimbursement, payment levels and ratios would be higher. In light of past research on the inflationary effects of usual and customary reimbursement, we regard it as significant that no evidence of higher Medicaid payments was obtained.

Finally, in terms of individual physician characteristics, the regression results indicated that variables associated with higher physician credentials (specialization, board certification, and appointment to a medical school faculty) tended to be positive in the level regressions but negative in the ratio regressions. Thus, while there appears to be some recognition of credentials in Medicaid reimbursements, these results are consistent with past findings that physicians with relatively prestigious credentials are less likely to accept Medicaid reimbursement as payment in full.

Implications

Empirical results presented in Chapter 7 reveal that, as of the mid-1970s, a majority of Blue Shield board members were selected by medical societies and many of these members were physicians. Indeed, medical society board selection and physician membership are so closely related that separate estimates of these two characteristics cannot be performed. Greater medical society involvement in board selection, as expected, leads both to higher Blue Shield payments for services and to higher physician participation in Blue Shield service benefits programs.

The two general policy issues relevant to this analysis are cost control and access to mainstream medical services of low-income populations. The results indicate that severing ties between organized medicine and Blue Shield may have benefits for cost control, in terms of lower fees and reimbursements for physicians' services. This policy "action" may also result in lower Blue Shield participation rates, which may be seen as a reduction of access to paid-in-full service benefits programs. However, theoretical considerations suggest that reduction of physician control of Blue Shield plans may also result in increased participation in other third-party payment programs. Thus, the "trust-buster" is not necessarily faced with a cost-access tradeoff. Severing ties between organized medicine and Blue Shield plans may well result in improvements on both counts.

Our findings on other aspects of physician/Blue Shield associations lead to some uncertainty about the precise ways in which such associations affect payments and participation. These findings, combined with the fact that the estimated impacts of the control variables on Blue Shield payments are by no means huge, suggest that actions to eliminate physician control of Blue Shield should not be viewed as a panacea for controlling costs of physicians' services. It is equally clear that some relationships between physicians and Blue Shield, such as presence on reimbursement committees, are necessary. Thus, while our findings indicate that appropriateness of antitrust attention toward the association between organized medicine and Blue Shield, there is much still to be learned about the consequences, both good and bad, of this association on performance of the medical care market.

Evidence from past studies has established conclusively that office-based physicians' decisions to accept Medicaid patients depend to an important degree on the level of Medicaid payments for physicians' services. Research presented in Chapter 8 has sought to discover why Medicaid payments vary and to identify potential policies either for increasing access of the poor to office-based physicians through more generous Medicaid payments or for limiting public outlays for physicians' services paid by the Medicaid program. Such decisions involve an access-cost tradeoff, but knowledge of the relevant policy instruments, and some idea of their relative strengths, can only help to inform the policy-making process.

Empirical results summarized here are supportive of the voter/taxpayer model of redistribution. But while the physician, as gatekeeper to mainstream medicine, influences far more than receipt of office-based services alone, it should be recognized that this study's analytic framework is confined to physician patterns and may or may not fit other dimensions of Medicaid as well. In any case, our empirical estimates of the impact of the federal share of state Medicaid expenditures on Medicaid payments to physicians are substantial. Federal sharing offsets to a large extent the natural tendencies of states to limit reimbursement in the face of low per capita incomes and/or high ratios of poor to non-poor population.

Although the voter/taxpayer model yields unambiguous predictions of the impacts of variables related to the demand for social welfare redistribution, the ways in which specific variables affect demand are more complex. The empirical findings suggest a slight tendency for state conservatism to be associated with a lower demand for such transfers, but no such tendency is detectable with respect to the proportion of black population. From the vantage of social policy, the latter result is reassuring.

The regression results indicate partial, but certainly not total, recognition of variations in practice costs and in physician credentials in Medicaid payments to physicians. Because we observe linkages between such factors and physician willingness to accept Medicaid patients, less than total recognition has some (negative) implications for access to mainstream medicine. If voter/taxpayers believe that the poor are less entitled to high cost/highly credentialed MDs than others, this practice is justified; however, if this policy is not supported by public preferences, additional effort to recognize practice costs and credentials in payments to physicians may be warranted.

Finally, it is known that public agencies vary in orientations toward medical care and in the degree to which they are subject to political pressures from various constituencies. Our finding of generally lower payments to physicians when Medicaid is operated by state health departments provides some indirect evidence of this. But because this study examines only one aspect of the Medicaid program, judgments on this score should be seen as preliminary.

HOSPITAL-BASED PHYSICIANS

Most economic research on physicians has focused on office-based MDs in major specialties such as general practice, internal medicine, and surgery. Recently, growing attention has been paid to hospital-based physicians (HBPs), the radiologists, pathologists, and other MDs who provide all their services in hospitals and clinics and whose practices are intertwined with the labor and non-labor resources of the facilities where they work. High incomes in these specialties have inspired the interest of policymakers and analysts and have directed attention to the idiosyncratic structural features of this corner of the physician services market. In particular, HBP contractual and compensation arrangements with hospitals have raised questions of relevance to antitrust enforcement agencies and to agencies responsible for monitoring and reimbursement of health care expenditures covered by Social Security Act programs. Expenditures for ancillary hospital services, those most often performed in HBP departments, have increased at a faster rate than hospital costs generally, which intensifies policy interest in HBPs.

The research reported in Section V consists of a descriptive analysis (Chapter 9) and a multivariate analysis (Chapter 10) of HBP practices in anesthesiology, pathology, and radiology. Because there has been less attention paid to HBPs than to office-based MDs in the past, relatively little descriptive information on HBP practices has been available. Chapter 9 attempts to fill part of this void; in addition, considerable information on trends in pathologist and radiologist compensation is presented. The multivariate analysis examines determinants of cross-sectional variations in HBP incomes, expenses, and workloads with special emphasis on the role of compensation method.

Both the descriptive and multivariate analyses are based on HCFA-NORC survey data collected in 1977 and 1978. A modified survey instrument was used to capture some of the special characteristics of HBP practices. The surveys yielded 543 physician observations on the three HBP specialties in 1977 and 501 in 1978. In most of the descriptive analysis and all of the multivariate analysis, these observations are pooled to increase statistical precision. Observations are also weighted to achieve representativeness and, as in the analyses of office-based physicians, biographic physician data and data on areas in which sample physicians reside have been merged to survey data to construct complete files for the multivariate analysis. Unfortunately, however, data on HBPs' primary hospitals were not available on the HCFA-NORC survey files, so this information is absent from the analysis.

Descriptive Analysis of HBPs

Much of the controversy surrounding HBPs centers on the methods by which they are paid. In particular, percentage compensation, wherein the HBP is paid a percentage of gross or net revenues (usually gross) of the department, has been criticized as especially inflationary and a major source of abnormally high incomes of some HBPs. However, trend data compiled from a number of sources (in addition to the HCFA survey) reveal that percentage forms of compensation, while still significant, are becoming less prevalent. This portion of the analysis pertains to pathologists and radiologists as anesthesiologists have traditionally been fee-for-service practitioners.

At the time of Medicare's inception in the mid-1960s, a majority of pathologists and radiologists were compensated on a percentage basis. Data from different sources (which are not entirely comparable, making inferences regarding trends only approximate) indicate a secular decline in this form of compensation through the 1970s. Fee-for-service compensation has grown in importance, especially for radiology. Salaried compensation has grown in incidence for pathologists but not for radiologists.

Reasons for these trends do not follow directly from any existing evidence but can be inferred. Prior to Medicare, percentage compensation was an economical method of dividing revenues for ancillary services performed in HBP departments. Medicare, however, imposed requirements for separating professional and hospital components of bills for ancillary services, thereby reducing the transactions costs advantages of percentage compensation of HBPs. At the same time, implementation of Medicare and Medicaid signaled a vast increase in both governmental and private third-party coverage for payment of physicians' private fees for ancillary and other services. Direct fee-for-service billing of patients by HBP physicians has therefore become relatively more attractive as an alternative to hospital billing with subsequent division of hospital and HBP revenues.

The differences in trends between radiologists and pathologists may be accounted for by differences in their respective outputs. Radiological services generally involve discrete acts associated with individual patients. Pathology services, however, tend to be produced in smaller units often without a direct patient service performed by a pathologist, making fee-for-service billing cumbersome and objectionable to some patients. This may account for the apparent preference of pathologists for salaried practice, as an alternative to percentage compensation, relative to radiologists.

HCFA-NORC survey data for 1977-78 (combined) indicate that 45 percent of pathologists are compensated by salary, 15 percent by percentage of department revenue, and 45 percent by fee-for-service. The corresponding figures for radiologists are 13 percent, 20 percent, and 67 percent, respectively. Comparisons between these data and other recent survey data on HBP compensation from hospital sources suggest that the HCFA-NORC data may slightly overstate the proportion of pathologists and radiologists on salary and understate the proportion of pathologists on percentage compensation. Nevertheless, the trend toward fee-for-service compensation away from percentage compensation is evident in all recent data on HBP practice characteristics.

An examination of income data for 1977-78 reveals that average compensation (net income plus retirement set-asides and other forms of deferred income) per hour of medical activity is highest for radiologists ($37.55) followed by pathologists ($35.83) and anesthesiologists ($28.41) and all HBPs earn more, on average, than the average for fee-for-service office-based MDs ($24.64). Net annual income excluding deferred income is a bit more precise than the above figures but similar relationships are apparent. Confining the comparisons to fee-for-service MDs only, the data indicate annual earnings of $73,322 for radiologists, $65,004 for pathologists, $63,810 for anesthesiologists, and $59,254 for office-based MDs.

Other descriptive evidence from the HCFA-NORC surveys is generally supportive of conventional beliefs about HBPs, but these data contain some surprises as well. For example, HBPs report a much higher level of tax-dexuctible expenses than one would expect, given their close associations with hospitals and clinics. For fee-for-service MDs, the mean ratio of net to gross income in 1976-77 was 0.65 for anesthesiologists, 0.72 for pathologists, 0.66 for radiologists, and 0.56 for office-based MDs. Some salaried HBPs report substantial practice deductions. HBPs, on average, receive considerable input subsidies from hospitals and clinics but many HBPs pay for all or a large part of their practice inputs, particularly labor.

the Medicare economic index

A byproduct of the descriptive analysis of HPBs is an examination of the influences of the Medicare program with particular reference to Medicare's economic index. The use of an economic index to set ceilings on the allowable increases in prevailing fees of physicians that may be deemed reasonable for reimbursement under part B of Medicare was mandated by the Social Security Amendments of 1972. The index is constructed so as to reflect physicians' expenditures on both real inputs (office space, clerical workers, etc.) and their own time in producing medical services. The limits on reasonable charges are increased annually by a maximum amount dictated by the increase in the index. The index is also affected by worker productivity; if productivity increases, the earnings portion of the index is reduced proportionately.

The index was first implemented in fiscal 1976 using 1973-74 data from the Bureau of Labor Statistics on economy-wide and health care industry-specific increases in costs, productivity, and earnings. Because experience with the index is limited, it is not yet possible to determine with precision how the index has affected physician fees generally. However, given the structure of the index, it is possible to deduce some differences in potential effects on HBPs vis-á-vis office-based MDs.

First, because the index presently does not recognize prevalent practice differences between HBPs and office-based MDs, it tends to give too much weight to increases in costs of office inputs, insofar as HBPs are concerned, because HBPs tend to have a larger fraction of such inputs subsidized by hospitals. Since input prices have been increasing in recent years faster than earnings, this suggests that the economic index has been less of a constraint on HBPs' fees than those of office-based MDs. The importance of this point is mitigated by the finding that HBPs tend to incur higher than expected practice costs.

Second, the economic index has the potential of influencing the trend toward fee-for-service practice of HBPs. An HBP who switches from some other billing/ compensation system to direct billing, fee-for-service practice has an advantage compared to existing direct-billing HBPs in that he is not constrained by past billing behavior. However, if the economic index acts as a real constraint on prevailing fees, this may be a disincentive to enter fee-for-service practice. Salaried remuneration, even though on average less than other forms of compensation, is subject to fewer controls than the alternate forms of compensation.

Clearly, there are substantial differences between office-based and hospital-based practice, and Medicare's economic index, as presently administered, does not recognize these differences. However, it is uncertain whether it would be worth the administrative and potential political costs to modify the economic index, and its administration, for HBPs. Medicare has had substantial influence on HBP practice since its inception in the mid-1960s. Whether or not application of the economic index will add to this influence remains to be seen.

Multivariate Analysis of HBPs

The multivariate analysis of HBP practices has a primary and a secondary objective. The primary objective is to identify sources of variation in HBP incomes, expenses, and practice outputs. Because HBP incomes have received considerable policy attention and income data are better measured on the HCFA-NORC surveys than the other two indicators of practice performance, the multivariate analysis emphasizes HBP income determination. The secondary objective is to identify sources of variation in HBP compensation among the three primary methods--salary, percentage, and fee-for-service. This analysis was performed, in part, to generate predicted probabilities of each compensation method for each HBP in the sample. Compensation method is logically seen as endogenous in systems that determine income and other measures of HBP practice performance. Thus, predicted probabilities are estimated via logit analysis and the predictions are entered on explanatory variables in income, expenses, and output regressions.

The compensation method logit regressions do not yield precise estimates of compensation method probabilities. Other research performed by the authors indicates that much greater success in estimating determinants of HBP compensation methods is achieved with the hospital, rather than the physician, as the unit of observation. In variants of the HBP practice performance regressions, actual compensation method is entered instead of predicted. The two types of compensation variables perform somewhat differently in these regressions but remaining explanatory variables are largely unaffected.

Coefficients of the actual compensation method variables tend to follow approximately the simple bivariate distributions of income and compensation method, with salaried compensation considerably below percentage and fee-for-service. Performance of the predicted compensation variables also implies that salaried compensation yields relatively low incomes but also that percentage compensation, *ceteris paribus*, yields incomes considerably above those of fee-for-service compensation. Neither form of the compensation method variables showed consistent impacts on ouptut per hour. It is tempting to assume that salaried compensation should be associated with lower output per hour than nonsalaried, but these results are consistent with past research in showing no substantial differences.

The empirical analysis indicates that HBP personal characteristics, especially sex and foreign origin, are important determinants of HBP incomes. The results suggest that female sex and foreign origin have a greater negative impact on income of HBPs than on office-based MDs, and these results cannot be ascribed to productivity differences.

Board certification and department chiefdom have modest positive effects on HBP income, but not nearly so much as nonsolo practice arrangements. Part of this difference may be due to greater bargaining power of nonsolo physicians in negotiating revenue sharing arrangements with hospitals. The regression results also indicate that income differences among the three HBP specialties, with anesthesiology lowest followed by pathology and radiology, tend to fall away when other factors are held constant.

Among characteristics of the HBP's market, per capita income has the greatest impact on HBP incomes, with elasticities in the 0.32 to 0.65 range. In contrast to some research on office-based MDs, per capita income completely dominates insurance coverage as a determinant of HBP income levels. The only consistent effect of insurance on HBP incomes is a negative impact of the proportion of patients covered by Medicaid which is probably due to the built-in constraints on physician payments by the Medicaid program. The supply of county physicians in the HBP's specialty per 1000 population also exerts a negative effect on HBP income, but this effect is not as great as on office-based physicians' incomes. For pathologists and anesthesiologists, the reduction in income as specialty-specific HBPs per 1000 population increases can be partially attributed to reductions in output per hour. For the most part, however, factors affecting HBP incomes do not have corresponding effects on output per hour, leading to the general conclusion that variations in HBP incomes are not largely determined by productivity variations.

On the whole, the multivariate analysis results on HBP income determinants are consistent with our research on determinants of office-based physicians' incomes. However, the analysis was unable to detect sources of much of the variation in choice of compensation method, expenses, and output per HBP hour. A more thorough examination of these factors would require information on both HBPs and hospitals based on a model that considers behavior of HBPs and hospitals jointly.

THEORY

There are few established consensuses in health economics on underlying models that govern physicians, hospitals, and other economic entities in the health services system. Consequently, many empirical research projects are based on behavioral models or on sets of limiting assumptions. In our research we attempt to illuminate underlying systems by drawing on economic and noneconomic theories of physician behavior both to guide our empirical specifications and to assist in interpretation of findings. All of the empirical chapters contain some theoretical underpinnings. In addition, in Chapters 11 through 15 we have focused on specific theoretical issues pertinent to physician behavior to supplement and provide further guidance to our empirical investigations.

Perhaps the most frequently debated theoretical issue in the market for physicians services is matter of demand inducement. Evidence of positive correlations between physicians' fees or earnings and the number of physician per capita has led many analysts to believe that physicians can shift demand for their services--often, it is believed, to achieve a target income. Sweeney addresses this issue in Chapters 11 and 12.

The most important finding of Sweeney's theoretical analysis is that evidence of a positive association between physician income and physician supply is not predicted by a detailed model of demand inducement with target income setting. In fact, if demand inducing physician behavior is assumed, the model implies no systematic relationship between price and any exogenous variables.

The assumption that physicians seek an income target (also known as "satisficing") implies that physician firms will never exceed their income targets but they may fall short. The likelihood of achieving the target, even when demand inducement is also assumed, depends in part on the number of other physician firms in the market. Thus, any empirical analysis of individual firm behavior must take into account the behavior of all firms in the market. An empirical investigation of the likelihood of achieving a target should consider both the determinants of income targets and the determinants of upper bounds to consumer expenditures on physicians' services in the market.

In Chapter 13 Sweeney provides a new slant to physician decision making by assuming that quality of service is a decision variable under control of the physician firm. The quantity of services demanded from individual physicians is assumed to be a function of price, the level of quality, and a set of exogenous variables such as patient income, insurance coverage, and so forth. The physician's cost function includes quantity and quality of services and a set of exogenous factors, and physicians are assumed to choose price and quality so as to maximize profits.

A possible reaction to a model of this sort is to respond that physicians are likely to provide the highest quality of which they are capable, implying that quality should not be viewed as a decision variable. When quality is defined broadly, however, to include amenities--elements of care valued by patients that do not necessarily affect medical risk or cure rates, the plausability of this model is enhanced. Such amenities would include short office waits and waiting time for appointments, "free" telephone consultations, pleasant office furnishings, and the like. In other writings, we often refer to the "quality-amenities" of the physician's output to make it clear that the broad definition applies.

Chapters 14 and 15 address theoretical topics in the market for physicians' services. In Chapter 14 Sloan considers theoretical effects of health insurance coverage on physicians' fees. The presence of this chapter is a reflection of our belief that specific characteristics of insurance programs must be examined to obtain a thorough assessment of the influences of insurance on physician behavior. In particular, implications of differences between "usual-customary-reasonable" (UCR) and fixed fee schedules are examined as are effects of levels of insurer payments and proportions of populations insured. The theoretical analysis indicates that the effects of changes in insured proportions and levels of insurer payments on usual fees cannot, in general, be unambiguously predicted.

In Chapter 15 Schlesinger provides a theoretical model of medical malpractice insurance and quality of physicians' services. The model investigates the possibility that the threat of malpractice litigation causes physicians to use more care as a form of self-protection. The availability of malpractice insurance, however, substantially lessens the role of care as a loss-protection mechanism. Physician risk aversion is positively related to the amount of malpractice insurance purchased. The effect of risk aversion on the level of care provided, however, depends upon the physician's loss probabilities. If the probability of a malpractice loss is low, an increase in risk aversion causes the level of care to increase. If the probability of a malpractice loss is high, an increase in risk aversion causes the level of care to decrease.

SECTION II

THE MARKET FOR PHYSICIANS' SERVICES

Chapter 2

The Market for Physician's Services: Background on Policy Issues, Theory, and Past Trends

Frank A. Sloan

INTRODUCTION

This background chapter serves several functions. First, we describe some key policy issues relating to the empirical analysis of physicians' fees, incomes, and workloads presented in Section II. In some instances this discussion goes beyond issues actually analyzed as part of our research. Second, alternative models of physician decisionmaking are presented. Although notions of physician target income and induced demand are considered in this chapter, more standard economic models guide our research in Section II. New empirical research conducted as part of this project is briefly described in this chapter and presented in full in later chapters. A third task is to provide background information on important variables exogenous to the physician's practice.

Cost concerns have attracted much attention to the health industry, especially since the mid-1960s, but the rationale for government involvement in health care has only recently become cost-related. In fact, the public sector's efforts to assure acceptable levels of patient access to health services at a satisfactory quality level are themselves likely sources of observed health care cost increases. Public policymakers and the voting public are not alone in their concern about rising health care costs. Private employers are becoming increasingly conscious of the amounts they annually spend on premiums and the fact that such outlays puts U.S. industry at a price disadvantage in relation to foreign competitors.

The physician is the undisputed "captain of the health care team." As Victor Fuchs (1974) has noted, at one time he was the entire team (p. 56). By the late 1970s, physicians constituted less than ten percent of total health care employment. (U.S. Department of Commerce, 1980, pp. 106 and 108). Expenditures on physicians' services constituted less than 20 percent of total spending on personal health services (Gibson, 1979, p. 24). However, physicians' small share of expenditures reflects and anomalous characteristic of the health care industry.

Although the physician makes the key decisions about the nature and extent of hospitalization and prescription drug use, these items appear separately in the national health expenditures accounts. Thus, the physicians' share of total health care expenditures greatly understates the physician span of control in health care delivery.

These national accounts are not the only place this split occurs. The Blue Cross and Shield plans and Medicare operate separate reimbursement systems for hospitals and doctors. Regulation in the health field encompasses these two groups simultaneously only rarely. Researchers and policy analysts generally focus on one part of the system or another, both because the analytic and policy issues of even a part are quite complex, and data bases rarely span the system as a whole. This study, which deals exclusively with physicians' services, narrowly defined, is no exception in this regard.

SPECIFIC POLICY ISSUES

The three major forms of government intervention in the health services field having the greatest impact on the market for physicians' services are health profession education, third-party financing of health services, and regulation.

Medical Education

The states have had a long history of support of medical education; the role of the federal government is much more recent. In response to a perceived shortage of physician personnel, Congress enacted the Health Professions Educational Assistance Act, the first legislation granting substantial federal support for medical education at the undergraduate level in the form of grants to medical schools for new construction, renovations, and alterations. This legislation was followed by several additional laws passed between 1965 and 1976 establishing scholarships and loans for medical students and capitation payments providing direct incentives for medical schools to expand educational capacity.

In 1976, Congress declared that supply and demand for physicians were in balance and, based on this judgment, greatly restricted the inflow of foreign medical school graduates into the United States. This assessment was made immediately after the medical education system has been encouraged to nearly double its capacity (from 8,772 first year medical students in 1963-64 to 14,963 in 1974-75); and, with new capacity on line, there were prospects for further growth in the numbers of physicians, far greater than the growth of U.S. population.[1] The consequences of policies designed to encourage increases in medical school capacity were predictable but not fully realized in practice.[2]

To gauge the desirability of policies affecting physician supply, information relating physician supply to a variety of pertinent outcomes is needed. For example, as the physician-population ratio in an area with a certain set of characteristics rises, what happens to expenditures on health care in general and on physicians' services in particular? What types of responses are noticeable on the utilization side? Is the access of particular segments of the population improved? Do physicians' fees fall or rise, and by how much? To what extent do various measures of patient access to medical care respond to changes in physician availability? Included among such measures are: travel time to the physician, patient waits in the physician's office, the length of time physicians and/or other staff spend with patients per visit, delays to an appointment, access to a physician at night and on weekends, and continuity of patient care. From the individual physician's standpoint, how is his or her income and workload affected by changes in physician supply? Estimates of various multidimensional impacts of supply changes are needed as input to decisions about public medical education policy.

A related issue concerns the mix of physicians. Whereas there is considerable disagreement on the adequacy of total physician supply, there is a virtual concensus of an imbalance between physicians in specialties emphasizing hospital-oriented care and those that emphasize primary care such as general-family practice, general internal medicine, pediatrics, and in some lists, office-based obstetrics-gynecology. Federal and state government policies increasingly reflect the view that greater emphasis on primary care medicine is needed.[3] Public policymaking in this area could use better basic knowledge about how specialty and various measures of physician credentials, including board certification status, affect physician practice patterns.

Third-Party Reimbursement

Between 1965 and 1978, the percentage of expenditures on physicians' services paid by patients directly out-of-pocket fell dramatically from 61.4 to 34.1. Most of this decrease occurred between 1965, the year immediately preceding Medicare and Medicaid, and 1970; during this period the out-of-pocket percentage declined from 61.4 to 44.2 percent, leaving another ten percentage points for the 1970s.[4] Much of the growth in coverage for physicians' services during the 1970s was for private insurance, especially major medical insurance plans.

Whether third-party reimbursement for physicians' services is desirable is no longer at issue. However, major questions remain. On a broad level, there are questions about the desirability of fee-for-service medicine versus alternative health care delivery systems, such as prepaid group practices, individual practice associations (IPAs), and/or health care alliances.[5] The alternatives preserve the concept of low or no patient out-of-pocket costs at the time services are received but change physician incentives both to provide services and to refer cases to other providers.

More narrowly-defined reimbursement issues concern persons charged with administering third-party programs, whether they be private or public, on a day-to-day basis. The overwhelming majority of insurance plans for physicians' services rely on and preserve the fee-for-service method of paying physicians. To what extent do higher levels of insurer payment for specific services cause fees to rise? Are particular payment mechanisms, such as the "usual-customary-reasonable" method, likely to result in higher fees than others? What is the impact of third-party coverage for physicians' services on the volume and mix of services provided?

Are there important imbalances in insurance coverage for different types of services? For example, services performed in the hospital appear to be much more thoroughly covered than services typically performed in office. What effects have these imbalances had on the mix of services?[6] If they are sufficiently serious, how can these imbalances be corrected most expediently? What effect has third-party reimbursement had on various dimensions of access and quality of physicians' services? Included in access are various "process of care" indicators, such as patient waits in the physician's office, appointment delays, patient access to physicians on nights and weekends, and amount of time physicians spend with patients per visit.

Quality is even more difficult to define operationally. For example, ordering an extra lab test may be good or bad quality, depending on the circumstances. Generally, the circumstances are difficult, if not impossible, to discern from an insurance claim form or (for that matter) from a survey of physicians' practices. Insurance may have altered the nature of physicians' services in beneficial ways. For example, a reduction in office waiting times is clearly beneficial to patients even though such benefits may not be reflected in improved health. If such alterations are important, the observed inflationary effects of health insurance on physicians' fees may be overstated.

Regulation

Although government regulation of physicians' services has a long history, physicians are, at present, less regulated than hospitals. In contrast to the hospital sector where regulation often has an explicit goal of cost containment,[7] most regulation in the physician's sphere, until very recently, has been based on the rationale of quality assurance. Physician licensure is the earliest and most important form of physician regulation. Because graduation from a U.S. medical school accredited by a committee of the American Medical Association is the major avenue for entry into the practice of medicine, licensure and medical education are inextricably linked. Entry of foreign-trained physicians is the other avenue, but it too is controlled by federal statute, most recently the Health Professions Educational Assistance Act of 1976.

Concern over rising health care costs and a desire to improve quality of medical care led to the legislation authorizing Professional Standards Review Organizations (PSROs) under provisions of the Social Security Amendments of 1972. According to this legislation, PSROs are to provide peer physician review of care provided in hospitals, extended care facilities, and skilled nursing homes and financed under the Social Security Act (except Title V). The law provides three principal methods for ensuring conformance with PSRO deliberations: (1) the PSRO's direct authority to deny approval of payments for services to physicians under Social Security Act programs; (2) a malpractice exemption protecting physicians who comply with, or rely upon, PSRO norms of treatment if the physician exercises due care during the course of treatment; and (3) specific sanctions imposed on physicians who do not provide care meeting "professionally recognized standards." If obligations under (3) are not met, the physician can be totally excluded from reimbursement under Medicare and Medicaid and subject to fines.

A number of other regulations relate to reimbursement policies. For example, the Federal Trade Commission has recently brought suit against Blue Cross-Blue Shield with the objective of prohibiting physician control of Blue Shield boards.[8]

Ohio's Attorney General's Office has succeeded in ending medical society sponsorship of a Blue Shield plan in that state.[9] Medicaid reimbursement is determined by both federal and state policy. New empirical evidence on some of these reimbursement-regulatory policies are presented in Section III of this report.

CONCEPTUAL CONSIDERATIONS

The standard economic model of competitive markets relies on the notion of consumer sovereignty, but this notion is subject to question in the context of medical care markets. It is often alleged that there is asymmetric information between health care providers and consumers. This gives the physician the opportunity to manipulate demand for his services; that is, the physician may order more services than the patient would demand if he were fully informed. A more benign view is that the provider serves the patient well. In other words, he acts as the patient's agent and selects medical services as if he were, in fact, the well-informed patient.

The concepts of asymmetric information and the agency relationship are often combined with the notion of income targeting. The physician presumably can manipulate demand so as to achieve a predetermined income objective. In some variants of the target income view, the physician has some qualms about selling extra services; or selling services takes away from his leisure time. Thus, there are costs as well as benefits from demand-shifting.

Even though the induced demand-target income model of the medical care marketplace has gained wide acceptance among non-economists, economists on the whole have been critical of this model. Yet, economists must recognize that the medical marketplace is indeed an anomaly in some respects. Their conceptual and empirical research and their policy analysis should reflect this.

Five alternative models of the medical marketplace are described below: competitive supply-demand model with homogeneous medical care output; monopolistic model with homogeneous output; monopolistic target model without induced demand, monopolistic model with induced demand; and a monopolistic model with heterogeneous output.

Competitive Supply-Demand Model with Homogeneous Output

The first model begins with defined short-run supply (S) and demand (D) curves for medical services in the community, both relating quantities of homogeneous services produced or consumed per capita (q) to the price of services (p). "Short-run" signifies a period during which the numbers of doctors and population can reasonably be assumed to be constant. Each physician in the market takes price as exogenous; price is determined at the point of intersection of S and D. Referring to Fig. 2-1, which depicts this case, D_0 initially intersects S_0 at A, which coincides with the per capita quantity-price combination (q_0, p_0). If the supply curve shifts for any reason, for example from an increase in places in state-supported medical schools, the supply curve shifts to the right. In Fig. 2-1, the shift is from S_0 to S_1. The new intersection occurs at B. Utilization of medical services per capita population rises from q_0 to q_1 while price falls from p_0 to p_1. The predictions of this model are independent of the slope and/or shape of the supply curve; by the Law of Demand, D has a negative slope.

The impact of an increase in the physician to population ratio on medical care expenditures per capita population (e) also commands policy interest. By definition, e = qp. Whether e rises or falls depends on the sensitivity of demand to price changes, the elasticity of demand. If the elasticity is less than one (in absolute value), the case in which a 10 percent decrease in p leads to less than a 10 percent increase in q, e falls with increases in doctor availability.

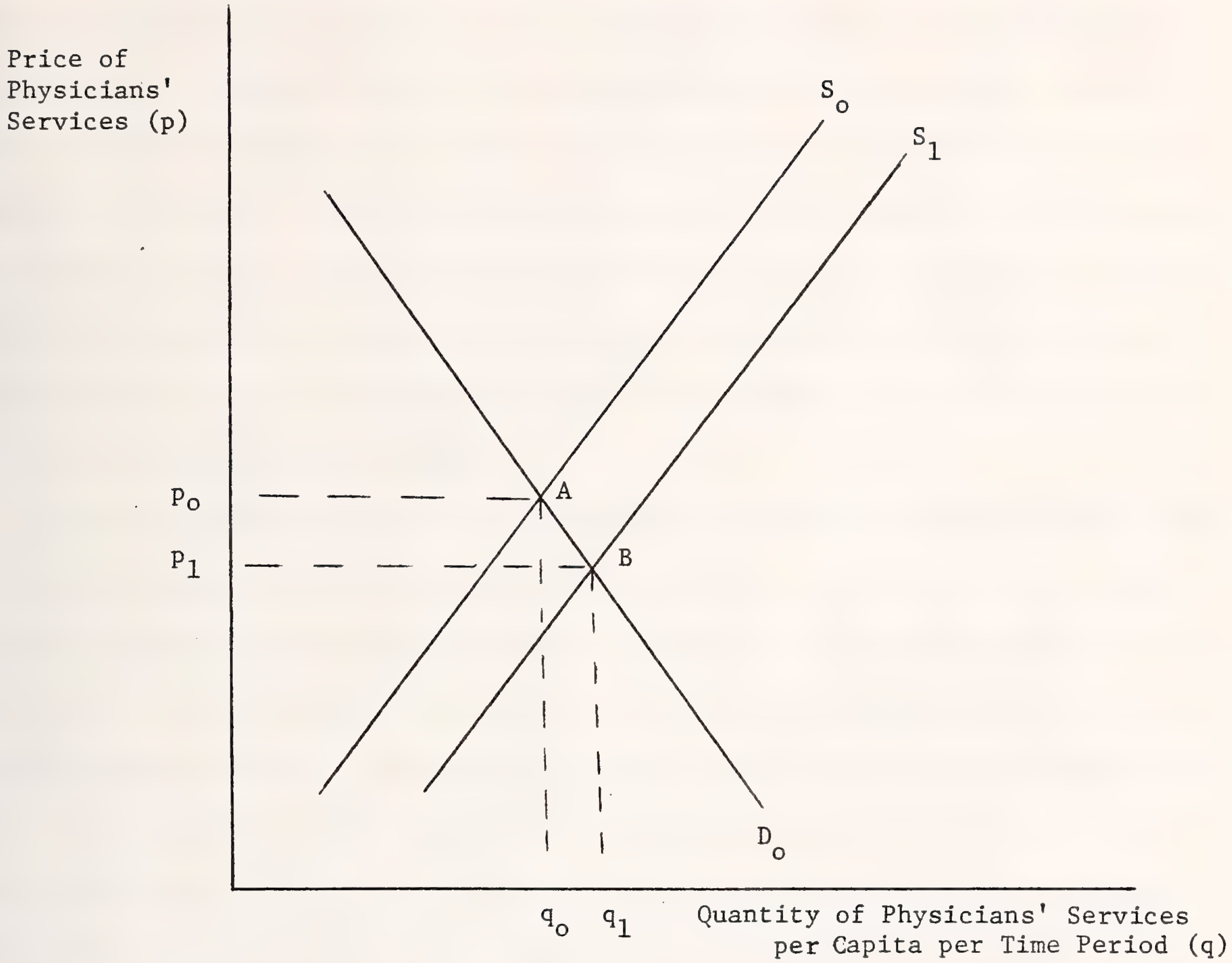


Fig. 2-1 Competitive Supply-Demand Model with Homogeneous Output

Conversely, if the elasticity is one, e remains constant or rises if the elasticity exceeds one. There is rather overwhelming empirical evidence that the elasticity of most types of medical care is less than one.[10] Hence, in combination with empirical evidence, this model implies that per capita expenditures on physicians' services should fall with outward shifts in the supply curve. Such shifts could result, for example, from increases in medical school capacity and/or a liberalized policy of admitting foreign-trained physicians into practice in the U.S. In fact, it was this type of reasoning that led Friedman and Kuznets (1945) and others to recommend removing entry barriers to medicine as, in more modern jargon, a cost containment policy. Gross incomes (g) and net incomes (y) of physicians would fall as well.

Matters may be somewhat more complicated than what has been described above. The demand curve has been drawn under the assumption that travel time to physicians is constant; presumably empirical estimates of the demand elasticity also hold travel time constant. But, in fact, with entry physicians will be closer to patients on average. A reduction in travel time would shift the demand curve in Fig. 2-1 to the right. In addition, a plausible argument can be made that this demand curve becomes more elastic as time costs fall.[11] Thus, even with inelastic demand for physicians' services and travel time held constant, it is possible that expenditures on physicians' services could increase as the number of physicians in the community increases. The same travel time effect does not apply in cases of changes in input prices and/or insurance coverage for physicians' services.

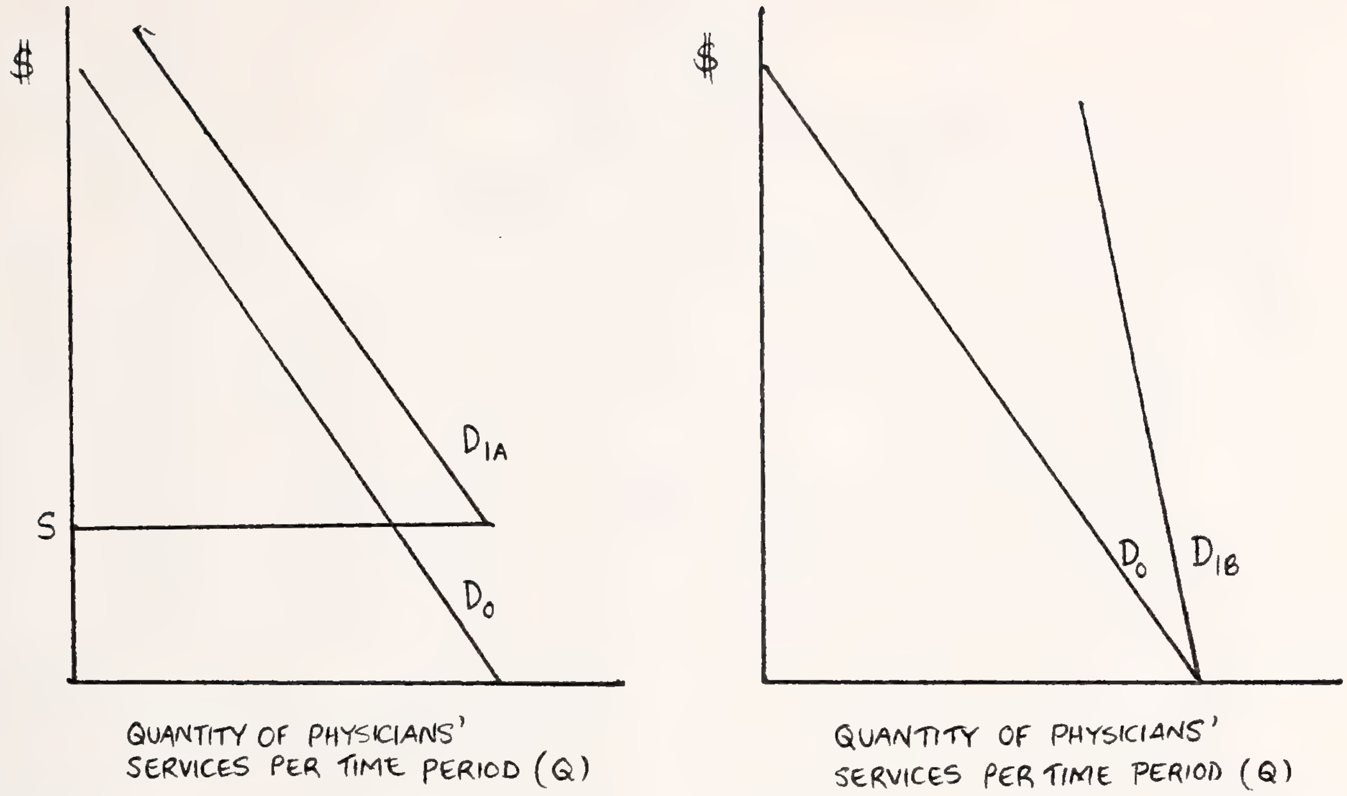
A rise in the price of an input in the production of physicians' services would shift the supply curve to the left, thereby raising price and lowering output and raising expenditues on physicians' services and gross revenue per doctor as well. Net incomes of doctors would fall unless the demand curve is completely inelastic, which is not likely.

An increase of insurance coverage for physicians' services shifts the demand curve to the right. The nature of the shift depends on the type of insurance. It can be shown that introducing a policy paying s dollars per service shifts the demand curve in a parallel fashion (Frech and Ginsburg, 1975; Sloan and Steinwald, 1975; Chapter 14) as in Fig. 2-2's Panel A. By contrast, a policy paying a proportion of covered expense rotates the demand curve about the point on the quantity axis which gives the amount of medical care the consumer wants to "purchase" at a zero out-of-pocket price. This shift is shown in Fig. 2-2's Panel B. In fact, both types of insurance coverage coexist, and for this reason the right demand shift is likely to be a hybrid of the two panels. The shift results in higher p, q, e, g, and y. Insurance is inflationary not only because it displaces the demand curve in the rightward direction but it also decreases the sensitivity of quantity to price.

If the supply curve has a negative rather than the positive slope in Figure 2-1, the model potentially becomes more complicated since conditions for a stable equilibrium may not be satisfied. Although backward-bending supply of physicians' services curves were obtained in early empirical work (for example by Feldstein, 1970), more recent studies report that the supply curve is positively sloped (for example, Brown and Lapan, 1979; Hixon and Mocniak, 1980).

Standard Monopolistic Model with Homogeneous Output

Because searching for the lowest-price doctor is costly, and in view of the fact that physicians and consumers are spatially separated, each physician may possess a degree of market power. That is, each physician may face a downward-sloping demand curve for his services and set price as well as quantity. This



DEMAND SHIFT DUE TO INTRODUCTION OF $ PAYMENT PER SERVICE

PANEL A

DEMAND SHIFT DUE TO INTRODUCTION OF MAJOR MEDICAL POLICY

PANEL B

FIG. 2-2 : EFFECTS OF HEALTH INSURANCE ON DEMAND FOR PHYSICIANS' SERVICES

model contrasts with the competitive model in which the individual physician takes price as given and can only vary quantity.

For simplicity, responses of a representative physician monopolist are examined. Over the relevant range the physician's marginal cost curve is upward sloping. Included in marginal cost are payments to non-physician inputs, but the most important element of cost is the wage the physician imputes to the time spent treating patients. This wage (per unit of time) presumably rises as output rises and is probably the most important source of increasing marginal cost.[12] Given cost and demand curves, the physician maximizes profits, which are defined as a return to the physician in excess of the wage he requires as compensation for foregone leisure time.

In contrast to the competitive case, an increase in the number of doctors shifts the demand curve for this representative doctor inward. To establish the impacts of increased physician supply on variables of interest, it is necessary to specify changes in the slope of the demand curve, which may occur as part of the leftward shift.

The simplest case is a parallel shift leaving the slope of the physician's demand curve unchanged. A traditional way of reasoning would be that entry would tend to flatten the demand curve (that is, make it more elastic) because the consumer is likely to have greater choice of physicians in the vicinity of his residence and/or workplace. In the limit, as sellers become more numerous the demand curve becomes infinitely elastic, the competitive case. If the new demand curve is parallel to the old one, or more elastic, it can be shown that both price and output of the representative physician fall with entry of new doctors. With both p and q down, gross income and net income fall.

The impact on total community expenditures on physicians' services (e) is more complex because all doctors in the community, not only our representative physician, would lower price in response to the leftward shift in their demand curves. With all doctors adjusting price, the industry rather than the physician's own demand curve is relevant. As price falls along a stable inelastic industry demand curve, e falls. However, to the extent patient travel time falls on average with entry of additional doctors, the industry demand curve will shift rightward. This makes it impossible to gauge the effect of an increase in physician supply on e.

Both increases in prices physicians pay for non-physician inputs and insurance coverage for physicians' services have the same effects (qualitatively) as in the competitive model. Although the individual doctor's demand curve is elastic at the profit maximizing levels of price and output, all physicians would change price in response to an exogenous change in wages of ancillary personnel, malpractice premiums, and/or insurance coverage. Hence, it is the elasticity of the medical care demand curve for the industry as a whole that governs expenditure responses to these exogenous changes.

Since there is no demand curve shifting, the demand curve still gives the maximum that patients are willing to pay for medical care at various quantities. If physicians are assumed to be target-income setters, however, there are several potential price-quantity combinations. These combinations are illustrated in Fig. 2-3.

In Panel A, the demand curve intersects the physician's "supply curve" at two points, both on the declining portion of the supply curve. The physician may locate at an intersection or at some price-quantity combination in between, such as C. If the physician locates at C, he must use various rationing mechanisms to distribute services since there is excess demand at this point. In Panel B, the demand curve intersects the supply curve at a point on the upward sloping

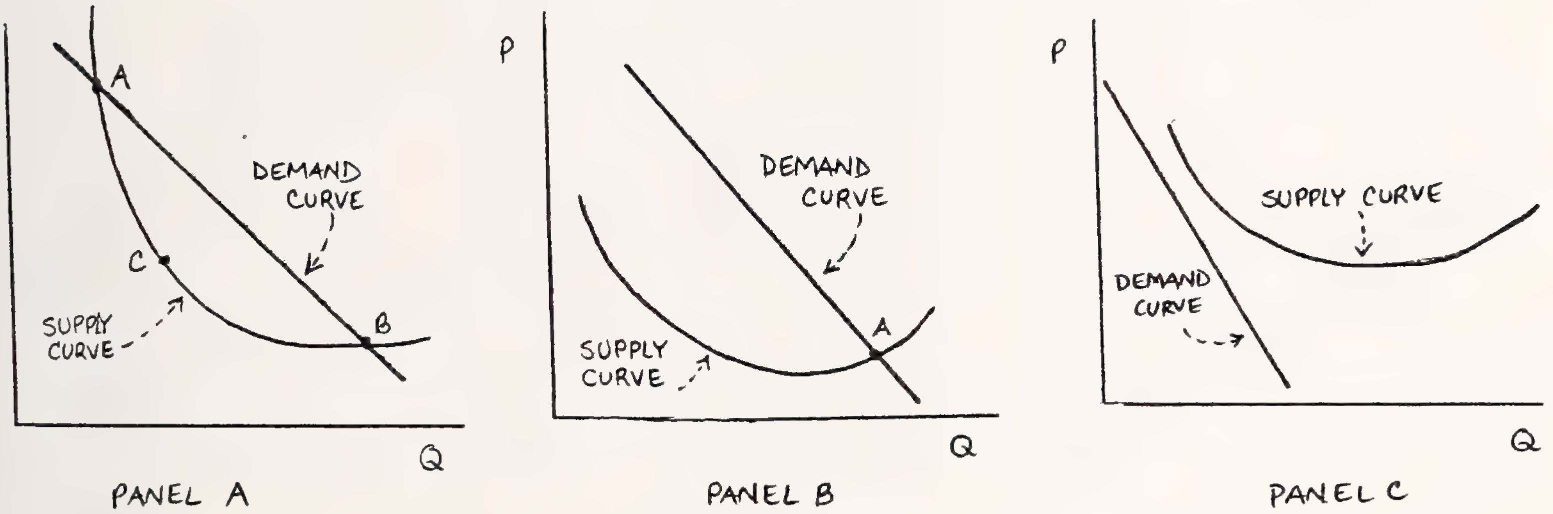


Fig. 2-3: Target Model with Stable Demand Curve

portion of the supply curve. In Panel C, the income target is unattainable. Presumably, in this case the physician either reduces his target or relocates.

To deal with disequilibrium in this context, Sweeney (Chapter 12) makes the following assumption. A physician supplies the quantity of services demanded from him in disequilibrium. If his resultant income exceeds his target income, he adjusts price in the direction of decreasing profit. If his resultant income falls short of his target, he adjusts price in the direction of increasing profit. Given this market clearing mechanism, there may be multiple stable equilibria. Additional assumptions are required to settle for a single price-quantity combination. For example, when confronted with two possible combinations, the "workaholic" doctor always selects the one with the higher quantity. Numerous assumptions could be made, and to do so here would take us far afield.

Unfortunately, predictions about the effects of changing physician availability, input prices, and/or insurance coverage are sensitive to the nature of the equilibrium, if, in fact, a price-quantity combination is selected at a supply-demand intersection. Without additional assumptions about physician behavior, the model yields no testable hypotheses about effects of changes in various factors exogenous to the individual physician on price and quantity.

Monopolistic Target Model with Limited Induced Demand

Typically, target-income setting has been combined with the notion that the physician can generate demand so as to achieve his target. These two ideas, taken in combination, presumably explain why physicians' fees and incomes and expenditures on physicians' services do not appear to fall in response to expanding physician supply.

First, suppose that the physician can shift demand without limit. In this extreme case there is no role at all for such demand variables as patient health status and income, insurance coverage, the number of physicians in the locality relative to population, and/or the physician's credentials. The target T_i* depends on a number of factors such as income in the doctor's reference group, the number of children the doctor wants to send to college, the number of wives he must support, and the like. There is an infinite number of price-quantity combinations satisfying equation (2-1), once the target has been determined. Possible empirical verification of the target income-unlimited shifting hypothesis would involve a finding that (1) demand variables have no impact on physicians' fees, workloads, and incomes; and (2) fees, workloads, and incomes depend on a variety of variables describing the reference group and personal characteristics of the physician and his family.

This model may be rejected as a "strawman" for three reasons. First, as indicated much more fully below, demand variables have been shown to be important empirically in studies of physician behavior. Second, the model really only has the potential of explaining differences in physician income. It offers absolutely no predictions about price and quantity.[13] Third, it has no strong backers, especially after the model's implications are explained and it is noted, for example, that physicians' incomes have been falling relative to the Consumer Price Index.

A more plausible variant combines targets with demand shifting over a limited range. Sweeney. (Chapter 12) described such a model in these terms. There are two demand curves, one for "minimum demand," which represents quantity demanded at each price when a doctor discourages demand to the maximum extent, presumably without losing patients, and the other for "maximum demand," which relates quantity demanded to price when the doctor encourages demand to a maximum extent, again without losing patients. Possible price quantity equilibria for the practice are shown in Fig. 2-4.

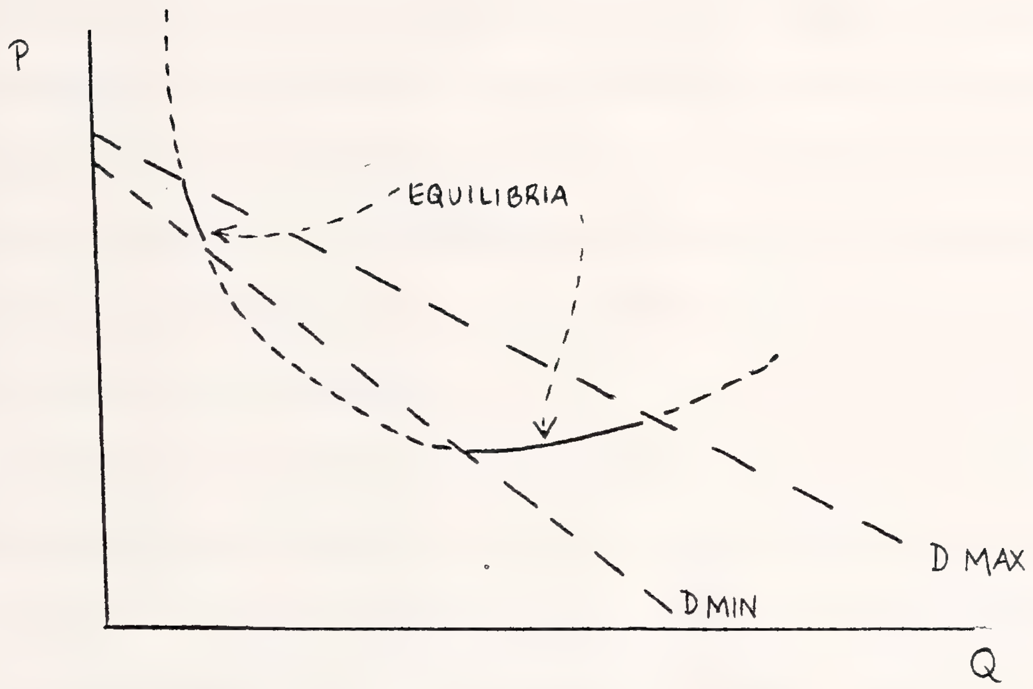


Fig. 2-4: Target Model with Limited Demand Shifting

Equilibria are to be found between the two demand curves along the solid portions of the supply curve. It is possible that D_{max} lies completely to the left of the supply curve, as in Panel C of Fig. 2-3. This limited demand shifting model is not fruitful for analyzing physicians' fees or workloads, but it does offer implications for empirical analysis of physicians' net incomes.

Let T_i^* be the target income of the ith doctor in the community. Assume that net income is proportional to gross income. Then the maximum amount the jth patient is willing to pay for medical care may be interpreted as the most the patient is willing to contribute to incomes of doctors in the community. Let M_j represent this maximum contribution for the jth consumer. Let R_i be the net income actually realized by the physician.

Realized income equals target income, that is, $R_i = T_i^*$, if the sum of target incomes of doctors in the community (ΣT_i^*) is less than or equal to the sum of maximum contributions of patients in the community (ΣM_j). Physicians get what they want because they do not exceed consumers' limits. If the sum of the M_js is less than the sum of the target incomes, the maximum contributions are limiting and physicians do not reach their targets; that is, for each doctor, $R_i < T_i^*$. Included among plausible determinants of T_j^* are reference group and personal characteristics of the physician described above as well as prices the physician pays for practice inputs. The M_j depend on demand factors described above. In this model, as the number of doctors increases relative to population, it becomes increasingly less likely that doctors' target incomes are acheived, even though over a wide range (before the limit $\sum_j M_j$ is reached), doctors can enter without affecting incomes of their competitors. Once the market is "saturated" with doctors, further entry does cause doctors' incomes to fall. The limit is reached later in communities rich in terms of insurance and income but poor in health.

Unfortunately, there is no way to classify communities on the basis of physician saturation in advance of empirical analysis. Therefore, empirical research based on this model requires a maximum likelihood technique that simultaneously estimates the importance of various determinants of T_i* and M_j and provides estimated probabilities that communities in the sample are saturated with doctors (that is, those for which $_{i}T_{i}^{*}$ $_{j}M_{j}$). If these probabilities are typically high, one may conclude that a standard economic model in which stable demand curves constrain doctor behavior is reasonably applicable. The opposite result would suggest that this standard model may not be appropriate for analyzing physician decision-making.

As explained more fully in Chapter 11, Sweeney tests the target with limited inducement model with data on physicians' net incomes. The empirical results imply that, for physicians in the five major fields (general-family practice, internal medicine, obstetrics-gynecology, pediatrics, and general surgery), income targets are most likely to be attained in small rural markets. The probability of attaining a target level of income in most of the large cities in the sample is virtually nil.

Standard Monopolistic Model with Heterogeneous Output

Up to now, all models have assumed a fixed and homogenous product. Even from casual observation, however, it is obvious that there is a substantial amount of variation in physician style and practice patterns. For example, some physicians provide quick treatment times while others are slow. Patients spend a long time waiting for some physicians while waits for others are relatively short. Some doctors are readily accessible on nights and weekends while others expect their patients to contact hospital emergency rooms during off-hours. More time with the physician, shorter waits, and greater accessibility during off-hours are all desirable characteristics that, in conventional economic models, make medical care more expensive. It can be demonstrated in theoretical terms that the nature of the medical product is potentially sensitive to changes in such factors exogenous to the individual physician as physician availability, factor prices, and insurance coverage for physicians' services.[14] Hence, these factors may affect price both directly and indirectly via their impact on the nature of medical care provided.

This model extends the standard monopoly model. The physician has one additional decision variable, namely the level of quality-amenities (a) he finds the most profitable to provide. With a few additional plausible assumptions, this model yields the following predictions:

An increase in physicians in an area is expected to decrease quantity per doctor but increase quality-amenities. The effect on price (p) is ambiguous because of offsetting effects of q and a. Both gross and net income per doctor should fall. The impact on total expenditures on physicians' services in the community is probably positive since the community demand curve for medical care shifts outward with increases in a and reductions in travel time. A rise in an input price causes q and a to fall with an indeterminate impact on p. Gross income may rise or fall but net income per doctor probably falls. The effect on expenditures is indeterminate. Added insurance coverage for physicians' services boosts q, a, and p. Gross and net income rise, as do expenditures.

Summary

Table 2-1 presents a summary of predicted effects of the alternative models. In many instances, theory provides no guide for hypothesis-testing; for these, economic theory by itself is of no use for distinguishing among alternative conceptual frameworks. In some cases, additional assumptions than those discussed in the text are needed to obtain predictions noted in the table. The next

Table 2-1: Predicted Effects of Exogenous Changes With Alternative Models of Physician Behavior

	Variable					
Model	q	p	g	y	a	e
Increase in Physician Availibility						
Competitive S-D	↓	↓	↓	↓	n.a.	?
Monopoly with Homo. Output[a]	↓	↓	↓	↓	n.a.	?
Monopoly Target w/o Induced Demand[b]	?	?	→or↓	→or↓	n.a.	↑or→
Monopoly Target w/ Induced Demand[b]	?	?	→or↓	→or↓	n.a.	↑or→
Monopoly w/ Hetero Output	↓	?	↓	↓	↑	↑
Increase in Price of Practice Input						
Competitive S-D	↓	↑	↓	↓	n.a.	↑
Monopoly w/ Homo. Output[a]	↓	↑	↑	↓	n.a.	↑
Monopoly Target w/o Induced Demand[b]	?	?	↑or→	→or↓	n.a.	↑or→
Monopoly Target w/ Induced Demand[b]	?	?	↑or→	→or↓	n.a.	↑or→
Monopoly w/ Hetero. Output	↓	?	?	↓	↓	?
Increase in Insurance Coverage for Physicians' Services						
Competitive S-D	↑	↑	↑	↑	n.a.	↑
Monopoly w/ Homo. Output[a]	↑	↑	↑	↑	n.a.	↑
Monopoly Target w/o Induced Demand[b]	?	?	→or↑	→or↑	n.a.	→or↑
Monopoly Target w/ Induced Demand[b]	?	?	→or↑	→or↑	n.a.	→or↑
Monopoly w/ Hetero Output	↑	↑	↑	↑	↑	↑

Notes:

a Predicted effects are based on model in which physician entry either increases or has no effect on representative physician's demand curve.

b First set of arrows refers to case where demand curve or demand maximum is not constraining; the second set refers to case with binding demand side constraint.

n.a. = not applicable to model.

section provides a discussion of factors likely to underlie variations in physicians' fees, incomes, and workloads. Empirical analysis throughout the body of this report is based on standard economic models of the firm.

SOURCES OF CHANGE IN PHYSICIANS' FEES INCOMES, WORKLOADS, AND SERVICE COMPOSITION

This section describes underlying variations in physicians' fees, gross and net incomes, workloads, and service composition and recent trends in these factors. The focus in this section and in the following chapters is on the physician's responses to various forces external to the practice. It is assumed that the individual physician firm controls price as well as practice inputs and output and the firm faces a stable demand curve. Several factors external to the practice affect both practice costs and demand curves.

Physicians' practice costs are affected by the prices of non-physician labor--such as nurses, receptionists, and technicians--and non-labor inputs, including the price of office space, medical supplies, and malpractice insurance premiums. Malpractice insurance involves more than an input purchase, since the threat of being sued is likely to alter practice patterns. "Defensive medicine," to the extent it actually exists, is presumably a response to this threat.

Key factors on the demand side are third party coverage for physicians' services, per capita incomes of the consuming public, the demographic structure of the population, and technology. Whether the state of technology is itself a result of insurance and per capita income rather than a separate exogenous force is certainly debatable.[15] Assuming as we do that the physician operates in an imperfectly competitive product market, from the vantage point of the individual physician practice, availability of other physicians in the community is a demand determinant. Under perfect competition, physician supply is a supply determinant.

As seen in Table 2-1, the effect of increasing the number of doctors in the community is much the same regardless of whether a monopolistic or competitive market is assumed.

Physicians' Incomes and Expenses

Most analysts realize that, at the margin, changes in aggregate physician supply and changes in utilization of institutional services have more serious implications for total health care expenditures than marginal changes in individual physicians' incomes. Nevertheless, the level of physicians' incomes and their variability across specialties and geographic areas have attracted policy interest for decades. Moreover, as indicated above, the question of how physicians' incomes are determined is one that health economists have vainly sought to answer for some time.

Table 2-2 presents 1976 data on physicians' incomes and expenses for selected major specialties from three different data sources: The HCFA-NORC Surveys, the AMA's Periodic Survey of Physicians, and surveys sponsored by Medical Economics, Inc. These data provide a basis for comparing physician renumeration and expense levels across specialties. Differences among the three data sources serve to illustrate that self-reported physician data do not yield precise estimates of incomes and expenses; nevertheless, interspecialty differences tend to be roughly equivalent across the three data sources. Implications of the data source differences are discussed in Appendix A.

All three sources indicate that radiology is the most lucrative and pediatrics the least lucrative of the six specialties presented in the table, and the difference in net income between these two specialties is substantial. In general, the specialties which are most technologically intensive, usually involving extensive use of hospital resources, tend to be the most lucrative. The fact that mean

Table 2-2: Net Incomes, Gross Incomes, and Expenses/Deductions for Selected Medical Specialties from Three Different Data Sources, 1976

	Anesthesiology	Radiology	Internal Medicine	General Surgery	OBGYN	Pediatrics
1. HCFA: Mean Net Incomes	$ 62,831	$ 70,391	$ 58,007	$ 63,022	$ 65,638	$ 49,911
2. AMA: Mean Net Income	60,059	77,322	60,459	73,245	65,800	46,962
3. HCFA: Median Net Income	55,463	65,024	54,860	64,657	64,830	45,437
4. AMA: Median Net Income	59,600	74,909	55,190	65,412	62,000	44,955
5. HCFA: Adjusted Median Net Income[a]	66,158	77,499	60,006	68,311	71,504	49,998
6. ME: Median Net Income[a]	--	--	60,000	69,910	76,120	51,300
7. HCFA: Median Gross Income	87,393	116,618	94,968	112,501	116,584	84,920
8. ME: Median Gross Income	--	--	101,450	103,820	130,270	84,540
9. HCFA: Mean Deductions	39,592	61,300	54,540	56,275	62,383	44,744
10. AMA: Mean Expenses	20,000	36,211	40,390	38,645	45,535	34,558
11. HCFA: Median Deductions	20,009	44,963	44,507	40,001	49,994	37,999
12. ME: Median Expenses	--	--	39,770	35,610	48,590	35,930

Data sources: HCFA - HCFA/NORC Survey of Physician Practice Costs and Incomes, 1977; AMA - American Medical Association Periodic Survey of Physicians, 1977; ME - Medical Economics, Inc. Physician Surveys, 1977.

[a] includes estimates of deferred income (primarily pension and profit-sharing plans).

reported incomes tend to exceed median incomes from the same data source indicates that the physician income distribution is skewed to the right. The same is true for physicians' expenses/deductions.

Lines 3 and 5 of Table 2-2 report HCFA median physician incomes without and with estimates of pension plan, profit sharing, and other forms of deferred income. Many physicians take advantage of an employment status that, with appropriate accounting devices, allows them to defer a substantial amount of current income. AMA income data routinely exclude deferred income and Medical Economics data routinely include it.

All physician specialties report substantial practice deductions/expenses. AMA and Medical Economics survey instruments request physicians to report practice expenses while HCFA surveys have requested deductions. Because deductions have systematically been higher than expenses, it is likely that physicians regard the former as a more inclusive category than the latter for unknown reasons. It is significant that hospital oriented specialties such as anesthesiology, radiology, and general surgery report expenses of the same order of magnitude as the other specialties. Hospital oriented specialties are thought to benefit from substantial input subsidies from hospitals and other institutions, but these subsidies apparently do not replace physicians' office expenses.

Prices of Practice Inputs

Table 2-3 shows components of gross physician income in 1978, based on a recent Medical Economics survey of physicians' practices. The most detailed breakdown is available from this source. Almost two-thirds of gross income goes to the physician, either in current or deferred income. The next largest items are, in descending order, payroll for non-physician personnel, office space, and malpractice premiums. Together, these four items account for over 85 percent of gross income. This percentage is a slight under-

Table 2-3: Components of Gross Physician Income, 1978

Item	Amount	Percentage Distribution
Payroll[a]	$14,933	14.0
Office space[b]	5,440	5.1
Malpractice premiums	2,987	2.8
Drugs and medical supplies[c]	2,773	2.6
Professional car upkeep[d]	2,240	2.1
Depreciation on medical equipment	1,280	1.2
Continuing medical education[e]	1,280	1.2
Other expense[f]	8,107	7.6
Net physician income	67,627	63.4
Gross physician income	$106,667	100.0

Notes:

a = Salaries, bonuses, and pension plans of non-physician employees.
b = Rent or mortgage payments.
c = Includes non-depreciable small instruments.
d = Includes depreciation.
e = Includes registration fees, cost of materials, travel, meals and lodging for physician only.
f = Includes utilities, dues, subscriptions, travel, entertainment, and legal, accounting, and management fees.

Source: Lavin (1979), pp. 138-47.

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Source: Lavin (1979), pp. 138-47.

statement in the sense that utilities, included by Medical Economics under "other expense," should be counted as a part of the cost of office space. Some of the remaining items, such as auto and continuing medical education, may be considered tax deductible perquisites rather than expenses.

Unlike the AMA, Medical Economics includes deferred income as part of net income rather than a tax deductible expense. Growth in deferred income may be one reason for differential growth between gross and net income as reported by the AMA. Some Medical Economics data suggest that practice expenses have been growing as a percentage of gross income. More specifically, although data are not available for physicians as a whole, professional expenses as a percentage of gross income for practices with three or four physician members were lower by one to three percentage points in 1970 than in 1978.[16]

Data on shares of gross income devoted to particular items are useful for determining the relative importance of variations in various input prices to the physician's practice. Although there is likely to be substitutability among the categories listed in Table 2-3, substitutability is probably greater within the categories. Hence, for example, salaries of non-physician personnel are likely to be comparatively important expense items over a broad range of relative factor prices.

A time series on wage rates of specific types of personnel employed by physicians is unavailable. However, such information is available for hospital employees. According to Sloan and Steinwald (1980), wage rates of hospital workers in the majority of occupations declined (in real terms) during much of the 1970s. For example, the real starting wage of a professional nurse declined 9.5 percent between 1970 and 1977; the real wage of a "secretary II" at the lowest step fell by 5.7 percent over this period. However, at least part of the increase in average wages probably reflects an upgrading of the overall quality of the hospital workforce. One may safely conclude that wage rates facing the physician practice, adjusted for increases in cost of living, have remained reasonably constant in recent years, but there has been some growth in fringes. The value of fringe benefits paid by hospitals to their employees increased at an annual rate of 19 percent between 1970-78 (Freeland, et al., 1979). Any increase in total real compensation of physicians' employees that occurred over this period probably took the form of higher fringes rather than increased real wages.

According to the AMA, office expenses, which by AMA's definition includes utilities, rose 6.5 percent per year between 1970 and 1978, the same growth rate as the overall Consumer Price Index.[17] For reference purposes, the components of the CPI for residential rent and home ownership increased at annual rates of 5.0 and 7.1, respectively, over this period.[18] Office expense, as reported, is at best a crude approximation of the true rental cost of space, since no imputation is made for a return to the physician's investment in his office and expenses are calculated in terms of original costs rather than replacement costs. Furthermore, as with wages, there is no way to hold quality of space constant. In spite of these shortcomings in the data, it is reasonable to conclude that the price of office space grew about the same as did prices in general.

The Malpractice Insurance "Crisis"

Malpractice insurance premiums increased dramatically during the 1970s: by more than 185 percent between 1969 and 1973 (Cooper and Stevens, 1977), by a factor of six between 1973 and 1976 (Munch, 1978), and then a very moderate increase (less than the growth of the CPI) between 1976 and 1978 (Greenspan, 1979, and Chapter 6). Even though there is some question whether the premium increases were fully justified by insurer claim experience (Munch, 1978), there is no question that the number and amounts of claims for malpractice against physicians have grown substantially.

As of 1978, after their rapid rise, malpractice premiums constituted only 2.8 percent of gross income (Table 2-3). There should be little concern for the effects of malpractice, either on the prices or quantity and quality of medical care, if malpractice premiums are considered just another practice cost. However, numerous statements by physicians about the increase in "defensive medicine" and a limited amount of empirical research suggest there is some reason for concern about malpractice effects on physician decision making. A recent study assessed the effects of premiums and the risk of being sued on physician price and output decisions. Greenwald and Mueller (1978) found that not only are malpractice premiums shifted forward to consumers, but the extent of fee increase is substantially more than required to recoup the extra cost. This result would be more interesting if the authors had not reported an even greater cost pass through attributable to increases in clerical worker wages. In addition to fee impacts, the authors also found that the amount of the malpractice premium is also a major determinant of the complexity of medical treatment administered by the physician. Effects of increased premiums are, in fact, so multifaceted and complex that, as argued in Chapter 5, very few effects can be deduced conceptually. The possibility exists that malpractice litigation causes the physician to use more care as a form of self-protection than the the absence of a litigation threat. Yet, with the availability of insurance, a possible physician response to the increased risk of being sued is to substitute insurance for care, resulting in a lower level of care than previously rendered. Holding the risk of being sued constant, a physician faced with a higher premium may raise his care level and reduce his insurance coverage.

As care levels rise in response to higher premiums, patient willingness-to-pay for the physician's service rises, as does the fee. Thus, the premium may raise the fee both directly, through its impact on the physician cost curves for all quality levels, and indirectly, through the effect of the premium on the quality of care the physician provides. It is worth emphasizing that this is only one explanation. This chain of events cannot be deduced unambiguously using economic theory (see discussions in Chapters 4 and 5 and Green, 1978).

Third Party Payment Programs

By the late 1970s, health insurance paid for 64 percent of expenditures on physicians' services. Of third party payments, private payors--primarily Blue Shield and commercial insurers--accounted for 60 percent and public payment programs--primarily Medicare and Medicaid--accounted for 40 percent (Gibson, 1980, p. 27). The most rapid increase in third party coverage occurred in the late 1960s, immediately after Medicare was introduced. Expansion of coverage for physicians' services since 1970 has been through growth of major medical insurance coverage on the private side and, more importantly, through growth in Medicare and Medicaid payments (Gibson, 1980, pp. 28 and 31). The third party (private and public) payer share of physician expenditures was highest in 1976 when it reached 66 percent. Since then this share has been declining (Gibson, 1980, p. 27).

Insurance for physicians' services consists of two principal types: basic benefit and major medical. Basic plans generally provide coverage for a range of specified services up to ceiling dollar amounts corresponding to each service. Under the indemnity variant of basic insurance, patients pay out-of-pocket for physicians' charges above the ceiling. The ceiling may be updated by the insurer across-the-board on a periodic basis, in which case the ceiling is a fixed fee schedule, or it may be tailored to the charges by the individual physician, using the Usual-Customary-Reasonable (UCR) method. Under UCR, the amount an insurer pays for a covered service is the lesser of the physician's "usual" charge (the U) and the "customary" charge in the market area (the C), defined as fee corresponding to a percentile cutoff, generally somewhere in the upper half of the fee distribution in the market area (often the 75th or 90th percentile). If the physician's charge exceeds the amount reimbursable according to the U and C criteria, a greater amount may be paid if the physician can justify his fee as reasonable (the "R" criterion). Under service benefit plans, as opposed to indemnity plans, the physician accepts the insurer's payment as payment-in-full.

Major medical insurance normally provides coverage for expenditures on medical care incurred during a specified time period rather than for specific procedures. Patients pay out-of-pocket for deductible amounts and co-insurance, the fraction of the charge above the deductible not paid by the major medical policy. Traditionally, insurers have paid "reasonable" charges under major medical. Screens are far less formal, and probably less stringent, than under UCR. Major medical may be coordinated with a basic plan--whereas basic plans often exclude services provided in the physician's office, such expenses are typically covered under major medical.

Private insurers offer both basic and major medical plans; historically, commercial insurers have sold proportionately more major medical policies and Blue Shield has sold more basic service benefit plans (Reed and Carr, 1970). However, in recent years this difference in product emphasis has become blurred. Medicaid is essentially a basic service plan with payments determined on either a fixed fee or a UCR basis, dependent on the state (U.S. Health Care Financing Administration, 1979). Medicare is a public major medical plan which uses a UCR-like system rather than the reasonable principle for determining payment levels.

Unlike Medicaid, the physician who treats a Medicare patient need not accept Medicare's maximum as payment-in-full. The determination as to whether the patient is accepted on a payment-in-full basis may be made on a case-by-case basis. A survey of physicians conducted in 1975-76 revealed that, in terms of generosity of payment, the private insurers (Blue and commercial) rank highest, followed by Medicare, and Medicaid being the least generous by far (Sloan, Cromwell, and Mitchell, 1978).

The empirical analysis in the following chapters contains essentially two types of insurance measures. The first, termed "weighted fee schedule," treats insurance payments as indemnities. That is, the insurer is willing to pay $X dollars for a given procedure, and the question asked is what effect this dollar amount has on the fee charged for that procedure. Let k_i be the proportion of a physician's patients with a specific kind of insurance, either Medicaid, Medicare, or private insurance, and s_i be the amount the insurer pays the physician when the procedure is performed. Then the weighted fee schedule is simply the sum of the s_i, each multiplied by its respective coverage proportion k_i, that is, $\sum_i k_i s_i$. Under plausible assumptions, the competitive supply-demand, monopoly with homogeneous output, and monopoly with heterogeneous output models all predict that increases in the weighted fee schedule will boost physician output, price, gross and net income, and expenditures on physicians' services. Data on the k_i and s_i are provided by physician respondents to the HCFA-NORC surveys.

The second insurance measure consists of proportions of the physician's patients with Medicaid, Medicare, and private insurance. Given the relative generosity of payments by payor type just described, the private insurance variable is expected to have the largest positive impact on the dependent variables in the following chapters and the Medicaid variable the smallest one.

Other Demand Factors

Per capita income increased at an annual rate of 8.7 percent between 1970 and 1978 compared with a 6.5 percent annual growth rate of the CPI over the same period (U.S. Department of Commerce, 1980, p. 445). Given the widespread availability of data on personal income, it is not surprising that empirical estimates of income effects on demand for health care services are far more widespread than is the case for insurance.

As is well documented, health status is correlated with age, and the U.S. population is growing older. Although it is difficult to gauge the impact of the changing age distribution on physicians' services from multivariate studies, some simple calculations roughly indicate the effects of age. With the distribution of expenditures for physician services in 1970 or 1978 as weights, it appears that the change in age distribution *per se* accounts for slightly over 0.5 percent per year in the compound rate of growth in expenditures on physicians' services.[19] A similar calculation on physician visits shows no change in visit rates due to changes in the age distribution.[20]

Physician Availability

For years there was widespread concern in the U.S. over a physician shortage. Largely in response to these concerns, federal and state programs were initiated during the late 1960s and 1970s that doubled the number of medical school entrants. At the same time, the number of foreign-trained physicians entering medical practice in this country grew substantially. Over the 1970s, the number of active, non-federal patient care physicians grew almost four times as fast as U.S. population, a trend accompanied by substantial changes in specialty composition. More recently, especially since the mid-1970s, there have been increasingly numerous expressions of concern, both in and out of government, about an impending surplus of physicians. Some practicing physicians are included among these concerned individuals.

Table 2-4 shows the growth of non-federal, patient care physicians over 1970-78. Overall, the growth in U.S non-federal patient care physicians during this period was 3.1 percent on an annual basis versus 0.8 growth for U.S. population (U.S. Department of Commerce, 1980, p. 14). Growth in particular specialties was much more rapid than this: cardiovascular disease (4.4); gastroenterology (6.1); general internal medicine (5.7); and general pediatrics (4.6). Losses or slow growth was experienced in: allergy (-0.6); general/ family practice (-0.2); general surgery (1.5); and radiology (1.8). The rapid inflow into the primary care fields of general internal medicine and pediatrics is most noteworthy as is the slow growth in the number of general surgeons.

Table 2-4: Non-Federal Patient Care Physicians, 1970 and 1978

Specialty	Number 1970	Number 1978	Compound Annual Percent Growth
Allergy	1,474	1.401	-0.6
Anesthesiology	9,567	12,942	3.8
Cardiovascular disease	4,821	6,830	4.4
Dermatology	3,439	4,591	3.6
Gastroenterology	1,374	2,531	6.1
General/family practice	54,098	53,019	-0.2
General surgery	26,016	29,304	1.5
Internal medicine	32,962	52,141	5.7
Neurological surgery	2,244	2,855	3.0
Obstetrics-gynecology	16,901	22,225	3.4
Ophthalmology	8,993	11,157	2.7
Orthopedic surgery	8,356	11,674	4.2
Otolaryngology	4,715	5,631	2.2
Pathology	6,989	9,687	4.1
Pediatrics	14,825	21,346	4.6
Psychiatry/Child psychiatry	18,153	23,630	3.3
Radiology	8,877	10,269	1.8
Urology	5,161	6,730	3.3
Total	255,027	325,783	3.1

Sources: Center for Health Services Research, American Medical Association (1971), p. 54, and Center for Health Services Research, American Medical Association (1979), p. 74. Several very small specialties are included in the total but not listed separately.

FOOTNOTES TO CHAPTER 2

[1] On enrollment trends in this period, see Crowley (1975), p. 1337.

[2] For projected physician-population ratios, see Reinhardt (1975).

[3] See Hadley (1980).

[4] Gibson (1979), p. 34.

[5] Alternative delivery systems are described in Enthoven (1980).

[6] The fact that these imbalances exist is well documented. See Blumberg (1979).

[7] See Steinwald and Sloan (1980).

[8] See Federal Trade Commission (1979).

[9] See Settlement Agreement, Ohio v. Ohio Medical Indemnity, Inc., Contract No. C-2-75-473 (S.D. Ohio, filed March 22, 1979).

[10] See Feldstein (1978), p. 92.

[11] Empirical evidence that travel time is negatively correlated with the community physician-population ratio is found in Sloan (1977).

[12] Alternatively, the physician may possess a utility function as in the competitive model. This approach was used in assessing price and output decisions with a monopolistic model by Reinhardt (1978). The theoretical analysis using either approach is basically the same.

[13] The model has been discussed in somewhat different terms by Feldstein (1978), Newhouse (1978), and Reinhardt (1978). A deficiency in all their discussions is that demand is not shifted in a way that holds income constant. If supply shifts out by, say ten percent, the demand curve need only shift out by ten percent to maintain gross revenue per doctor. If this is so, there would be no change in price, although quantity would increase. All of these graphical presentations show price changes.

[14] See Sloan and Feldman (1978), Sloan and Lorant (1977), and Guterman, _et al_. (1978).

[15] The argument that technological change in the health field is a result of increasing demand is presented in Feldstein (1971).

[16] Owens (1971) and Lavin (1979).

[17] Center for Health Services Research and Development, American Medical Association (1980), p. 207 and Center for Health Services Research and Development, American Medical Association (1973), p. 157.

[18] U.S. Department of Commerce (1980), p. 483.

[19] The expenditure weights came from Fisher (1980); pp. 65-90.

[20] Data on 1978 visit rates by age from the Health Interview Survey (HIS) conducted annually by the U.S. National Center for Health Statistics are published in Fisher (1980). Data on 1970 visit rates from the HIS are published in Sloan and Bentkover (1979).

Chapter 3

Physicians' Fees and Length of Visit

Frank A. Sloan

INTRODUCTION

The empirical analysis of physicians' fees is based on the HCFA-NORC surveys conducted during 1977 and 1978. Office-based physicians in 15 specialty areas are included in the analysis. Data from the two surveys are combined to increase the number of cases. This is especially useful for the fee analysis because many of the procedures analyzed are performed only by physicians in a single specialty. Because the survey file contains the name of the physician's hospital of primary affiliation, it is possible to assess the influence of hospital characteristics on physician fee-setting behavior. In addition, the survey file contains information on physician credentials and on characteristics of counties where sample physicians are located. Combined with detailed information from the HCFA-NORC surveys, these data comprise a more thorough file for fee analysis than has been available to researchers in the past.

Information on physicians' usual fees and insurer payments is available for 29 procedures from the 1977 survey and 30 procedures from the 1978 survey. With the exception of follow-up office visit and follow-up hospital visit fee and insurer payment questions, which were asked of all physicians surveyed, respondents were queried about fees and fee schedules for one to three procedures in their respective specialties. For example, ophthalmologists were queried about usual fees and fee schedules for eyelid drainage and single cataract removals as well as for follow-up office and hospital visits.

For several reasons, there is a substantial loss in usable observations from the total number of cases from the combined 1977 and 1978 surveys.[1] The regression analysis is therefore confined to the following common procedures: follow-up office and hospital visits (designated by abbreviations FOV and FHV, respectively, below); proctoscope by internists (PRC); electrocardiogram by (general) internists and cardiologists (EKG); gall bladder removal (GBL) and single inguinal hernia repair (HRN) by general surgeons; and diagnostic D and C (DAC) by obstetricians-gynecologists.

All monetarily-expressed variables in this and later chapters are deflated by an area cost-of-living index which, in addition to accounting for area variation in prices, coverts 1978 monetarily-expressed variables into 1977 dollars.[2] As briefly described below, data from a number of other sources have been merged with the combined 1977-78 HCFA-NORC survey file.

The empirical analysis in this and the following chapter is based on the standard economic framework described in Chapter 2. Empirical specification of the fee equations is found in the next section of this chapter and fee regression results are presented in the ensuing section. These results are followed by length-of-visit regression results which were estimated to determine whether the same factors that influence fee-setting behavior also have qualitative effects on the physician's product. The chapter ends with a summary and implications discussion.

SPECIFICATION AND HYPOTHESES

The dependent variables are fees for seven procedures. Only two, the follow-up office visit and follow-up hospital visit fees, apply to all included specialties. Explanatory variables fall into the following categories: specialty; other physician and practice characteristics; area product demand; and factor prices. The individual physician is the observational unit.

In the visit fee regression, binary variables are defined for each specialty except general-family practice which is the reference category. Family practice is a relatively new field; the vast majority of physicians in the general-family practice category are actually general practitioners. Since each of the listed specialties requires more formal training than general practice, fees should be higher in the specialty fields holding other factors constant. In addition, some differences in estimated coefficients are expected because of interspecialty differences in the nautre of a follow-up office and hospital visit. With one exception, specialty variables are omitted in regressions for fees other than the office and hospital visit since the procedure only applies to one specialty. The exception is the fee for an electrocardiogram which includes both cardiologists and general internists; in this case, cardiology is the omitted reference category.

Sixteen binary variables fall under the heading "other physician and practice characteristics." Board certification status is an indicator that the physician has taken a residency in a specialty for a specified amount of time and demonstrated proficiency on tests. Other physician credentials relate to the medical school attended. Five binary variables have been developed from information based on ratings of medical school quality from the Gourman Report (1977). This report ranks U.S. and Canadian medical schools and identifies distinguished programs in other countries. Binary variables for the "distinguished" and "undistinguished" U.S. medical schools identify graduates from schools in approximately the highest and lowest quartiles. The variable "third world FMG" refers to a graduate from foreign medical school in a non-Western-European country not on the "distinguished" list, and "other FMG" refers to the remaining foreign medical school graduates. The omitted reference category consists of graduates from U.S. medical schools in the second and third quartile rankings.

Graduates of classes less than 10 or more than 35 years prior to the surveys are identified by separate binary variables. The vast majority of doctors fall in between these two extremes. It is often said that young physicians now charge the highest fees, or at least fees nearly equal to their more experienced counterparts. If so, this pattern may reflect the incentives for young doctors to set a high usual fee for purposes of third party reimbursement under usual-customary-reasonable (UCR) health insurance programs.

The vast majority of physicians, 97 percent in the HCFA-NORC sample, have an affiliation with at least one hospital. The hospital provides non-physician and sometimes resident physician inputs at no financial cost to the physician. To the extent that input intensive hospitals provide office-based physicians with more inputs, fees of physicians affiliated with such hospitals may be lower, *certeris paribus*. This would occur if at least part of the cost savings to the physician's practice from hospital-supplied inputs are passed on in terms of reduced fees. However matters are somewhat more complex than this. Input intensity on the hospital side may primarily result in a higher quality hospital product, and the ability of physicians to substitute hospital-supplied inputs for those they must purchase may be no higher than when the hospital employes few inputs per unit of hospital output. To the extent this is so, input intensity should have no effect on fees. Whereas there are reasons for negative and zero impacts of hospital input intensity on fees, there is also reason for a positive impact, namely that higher "quality" physicians may be affiliated with input-intensive hospitals, and the explanatory variables may not have captured all dimensions of physician quality. Hence, on balance, the effect of hospital affiliation on fees cannot be determined by *a priori* reasoning and must be ascertained empirically.

In this chapter, three binary variables describe hospital affiliation: affiliated with medical school hospital; affiliated with limited teaching hospital (no medical school connection but hospital has residents); and no hospital affiliation. The majority of doctors (58 percent) fall in the omitted reference category, affiliation with a non-teaching hospital. Teaching hospitals are thought to be more input-intensive than non-teaching hospitals; thus, the effects of hospital input intensity on physicians' fees should be more apparent in the case of teaching hospitals.

Almost half (48 percent) of the physicians in the sample practiced in incorporated practices at the time of the surveys. The corporate form offers advantages to physicians such as establishing pension plans and holding limited amounts of funds within the firm for later use in practice-related investments. Group practices may differ from their solo counterparts in terms of efficiency. Binary variables distinguish among the following types of practices: incorporated with six or more physicians in the practice; incorporated with two to five physicians in the practice; solo incorporated; unincorporated with two or more physicians in the practice; and solo unincorporated--the omitted reference category. Finally, a binary variable distinguishes female from male physicians. Six percent of the sample is female.

"Area product demand" variables encompass per capita income, population density, physicians per 10,000 population, and insurance for physicians' services. All variables except insurance are defined for the county in which the physician is located. The insurance variables are practice-specific.

Demand for physicians' services is higher in areas with high per capita income. Population density (population per square mile in county) may be considered a demand determinant; it may also pick up some variation in factor prices not captured by the factor price variables.

Except in rural counties in which the physician is the only practitioner, or one among few, the area physician-population ratio may plausibly be viewed as an exogenous product demand determinant from the vantage point of the individual practitioner. However, since some may question the exogeneity assumption, some fee regressions have been estimated with a predicted ratio of non-federal patient care physicians per 10,000 population in the physician's county as an explanatory variable rather than the actual ratio. The regression used for the prediction contains the following explanatory variables: population density; medical school enrollment; and indicators of the attractiveness of the area--hotel receipts per capita population, January and July temperature, humidity, rainfall, a binary variable which is one for counties with elevation less than 200 fee, number of assults per 100,000 population, and blacks and Spanish-surnamed individuals as a percentage of the total population. Nearly all coefficients of the estimated prediction regression are statistically significant at the one percent level with plausible signs, and the R^2 is 0.75, quite high for a regression based on a single cross-section.

A third physician supply variable, the number of physicians per 10,000 population for the SMSA for metropolitan physicians and the county for those physicians (the minority) located in nonmetropolitan counties, was entered in some regression variants. All three alternative physician-population ratios show about the same impacts on fees. For this reason, regressions with only one ratio, the actual county physician-population ratio, are presented. When specialty-specific fees are the dependent variable, the county physician-population ratio pertains to the relevant specialty rather than to all non-federal patient care physicians.

The insurance variables are based entirely on responses to survey questions. To avoid biased and inconsistent parameter estimates in the fee regressions, insurance equations with the following dependent variables were estimated at a preliminary stage of the analysis: proportion of physician's patients covered by Medicaid;[3] and procedure-specific fee schedules for Blue Shield, Medicare, and Medicaid.[5] Predicted values from the regressions are employed as explanatory variables in the fee regressions. Since Blue Shield and commercial fee schedules are highly correlated, the proportions of the physician's patients with Blue and commercial coverage have been combined, and the Blue Shield free schedules are taken as representative of those of all private insurers. Although some may argue that the privately insured and Medicare patient proportions are endogenous, the case is far weaker in the case of these variables than for the fee schedules and the Medicaid patient proportions. Private insurance and Medicare proportion variables are considered exogenous fee determinants in this study. Adding additional endogenous variables without very good reason would incur a substantial cost in terms of multicollinearity.

There are three alternative specifications of insurance. In the basic model, payor-specific fee schedules are weighted by the proportions of patients by payor type to form a single fee schedule. In this and the other two specifications, empirical counterparts to k in the previous chapter are the proportions of physicians' patients with certain types of insurance. This measure of k is less than ideal because it does not account for specific benefit exclusions, for example, when office visits are excluded from coverage. However, the shortcoming is offset at least in part by the design of the fee schedule questions. If a "typical" patient's policy did not pay for a specific procedure, the physician generally gave an answer of zero or the entry was left blank. The fact that there are benefit exclusions is reflected in the weighted fee schedule, albeit imperfectly, but by responses to queries about the dollar amounts various insurers pay for specific procedures rather than by proportions of patients with specific types of coverage.

The second specification includes separate variables representing the proportions of patients with private insurance (actual responses), Medicare (actual responses), and Medicaid (predicted values). Fee schedules tend to be highest for the private insurers and lowest by far for Medicaid, with the exception of office visits, which are often excluded from private policies.[5] This factor should be reflected in the estimated insurance proportion parameters. Ceteris paribus, practices with high fractions of privately-insured patients should have highest fees and Medicaid patient-oriented practices the lowest.

In the third specification, insurance variables are proportions of patients by type of insurer multiplied by the predicted fee schedule for that insurer. Unlike the first specification, the third contains separate variables for private, Medicare, and Medicaid coverage.

Finally, there are three factor price variables: the weekly wage for hospital employees in the physician's county, an estimate of annual rent, and the malpractice premium. The hospital wage has been computed from unpublished data generated by the unemployment insurance program and collected by the U.S. Bureau of Labor Statistics. Annual rent has been constructed from 1970 U.S. Census of Housing data on median residential rentals by county updated to the survey years with Bureau of Labor Statistics cost-of-living data. More specifically, the BLS publishes estimates of housing costs annually for major U.S. cities and for non-metropolitan areas in each of the four Census Areas (Northeast, North Central, South, and West). Since the list of cities covered by the BLS is limited, it was necessary to make assignments. The same assignment algorithm was used as for the area price deflator. The malpractice insurance premium data are specialty, state, and year specific. These data come from the U.S. Health Care Financing Administration and from personal telephone calls to the states in a few cases.[6] All fee equations are estimated in linear form.

EMPIRICAL RESULTS ON FEES

Means and standard deviations of the dependent fee variables are presented in Table 3-1. Table 3-2 presents estimated office visit (FOV) and hospital visit (FHV) fee equations, using the three alternative specifications of the insurance component. Table 3-3 shows regressions for five other more specialized procedures. Estimated elasticities are presented in Table 3-4.

Table 3-1: Means and Standard Deviations of Fees for Seven Common Medical and Surgical Procedures, 1977-78, in 1977 Dollars

Procedure	Mean-fee	(s.d.)
Follow-up office visit (FOV) for physicians in 15 specialties---	$14.42	(4.92)
Follow-up hospital visit (FHV) for physicians in 15 specialties---	$16.32	(6.15)
Proctoscope exam (PRC) for internists ---	$25.27	(7.81)
Electrocardiogram (EKG) for internists and cardiologists---	$22.29	(7.92)
Gall bladder removal (GBL) for general surgeons---	$595.60	(169.43)
Single inguinal hernia repair (HRN) for general surgeons---	$371.23	(111.77)
Diagnostic D & C (DAC) for obstetricians-gynecologists---	$194.74	(58.84)

Source: HCFA-NORC Surveys conducted in 1977 and 1978.

Overall, the regressions' explanatory power tends to be high, especially considering that the analysis has been conducted with microdata. A large number of parameter estimates, particularly in Table 3-2, are statistically significant at conventional levels, which is not unusual in view of the large number of observations. In general, the parameter estimates are quite insensitive to alternate specifications (including many regressions not shown), but there is one exception. Several coefficients are sensitive to the inclusion of the predicted percentage of the physician's patients with Medicaid. Although inferior conceptually, inclusion of the actual Medicaid percentage in regressions not shown substantially reduces multicollinearity. Whereas the predicted variable's coefficients imply that having a high percentage of Medicaid patients in the market area reduces fees, coefficients on the actual Medicaid percentage variable uniformly imply no effect.

Holding numerous other factors constant, it appears from Table 3-2 that with few exceptions specialists' fees for office and hospital visits tend to be higher than those of their general-family practitioner counterparts, the omitted reference category. This result is not surprising in view of the additional training of specialists. Only a small minority of physicians in the general-family practitioner category are family practitioners, a specialty with residency programs. Variations in the nature of a visit are also embodied in the specialty coefficients; more will be said about this below when the length-of-visit results are discussed.

Taken as a group, neither board certification status nor the type of medical school attended have uniform and important impacts on fees. The board certification status coefficients are positive and statistically significant in Table 3-2 with the exception of regressions containing the predicted Medicaid patient percentage for which board certification is a predictor. However, the variable shows no effect in Table 3-3. Medical school type is unimportant in both. A logical interpretation of this latter finding is that patients do not value dif-

Table 3-2: Office and Hospital Visit Fee Regressions

Explanatory Variables	Dependent Variable 1.FOV	2.FOV	3.FOV	4.FHV	5.FHV	6.FHV	Means and Std. Devs.(·)
Specialty							
Allergy	1.51[a]	-0.24	2.86[a]	1.78[a]	-1.56[b]	3.52[a]	0.04
	(0.31)	(0.49)	(0.38)	(0.48)	(0.73)	(0.58)	(0.20)
Cardiovascular disease	4.43[a]	2.98[a]	4.84[a]	3.18[a]	0.77	4.06[a]	0.03
	(0.35)	(0.48)	(0.48)	(0.48)	(0.68)	(0.67)	(0.17)
Dermatology	1.68[a]	0.76	2.16[a]	2.07[a]	0.43	3.50[a]	0.04
	(0.32)	(0.39)	(0.37)	(0.53)	(0.62)	(0.63)	(0.19)
Gastroenterology	4.32[a]	3.71[a]	4.33[a]	2.55[a]	1.58[a]	3.49[a]	0.03
	(0.38)	(0.42)	(0.45)	(0.53)	(0.60)	(0.64)	(0.31)
General surgery	-0.28	-0.49[a]	-0.05	-1.49[a]	-1.49[a]	-0.57	0.11
	(0.24)	(0.24)	(0.27)	(0.35)	(0.36)	(0.41)	(0.31)
Internal medicine	2.89[a]	2.80[a]	2.50[a]	2.31[a]	1.90[a]	2.39[a]	0.12
	(0.22)	(0.23)	(0.27)	(0.30)	(0.33)	(0.38)	(0.33)
Neurological surgery	5.16[a]	5.57[a]	5.58[a]	2.26[a]	2.02[a]	2.80[a]	0.04
	(0.35)	(0.34)	(0.38)	(0.47)	(0.49)	(0.53)	(0.19)
Obstetrics-gynecology	2.27[a]	0.70[c]	2.81[a]	-1.49[a]	-4.12[a]	0.28	0.13
	(0.24)	(0.39)	(0.30)	(0.39)	(0.60)	(0.48)	(0.34)
Ophthalmology	2.93[a]	3.14[a]	2.21[a]	0.84	0.81	0.96	0.04
	(0.30)	(0.30)	(0.38)	(0.59)	(0.54)	(0.63)	(0.21)
Orthopedic surgery	0.38	-0.71[c]	0.90[b]	-1.84[a]	-4.31[a]	-0.94[c]	0.05
	(0.32)	(0.40)	(0.37)	(0.48)	(0.60)	(0.55)	(0.21)
Otolaryngology	0.97	0.97[a]	0.90[a]	-0.69	-0.97[c]	-0.35	0.04
	(0.31)	(0.31)	(0.34)	(0.51)	(0.52)	(0.57)	(0.21)
Pediatrics-Pediatric surgery	0.05	0.79[a]	-0.46	0.91[a]	2.06[a]	0.48	0.14
	(0.21)	(0.25)	(0.27)	(0.29)	(0.35)	(0.37)	(0.19)
Urology	0.72[b]	0.61[c]	0.62	-1.41[a]	-2.02[a]	-0.83	0.04
	(0.33)	(0.34)	(0.40)	(0.48)	(0.50)	(0.58)	(0.19)
Other Physician and Practice Characteristics							
Board certified	0.38[a]	-0.29[c]	0.60[a]	0.17	-0.81[a]	0.66[a]	0.59
	(0.12)	(0.15)	(0.14)	(0.18)	(0.23)	(0.22)	(0.49)
Distinguished U.S. med. school	0.08	0.05	-0.003	0.05	0.02	0.17	0.22
	(0.14)	(0.14)	(0.16)	(0.21)	(0.21)	(0.24)	(0.41)
Undistinguished U.S. med. school	0.39	0.22	0.49[a]	0.64[a]	0.41[c]	1.02[a]	0.14
	(0.16)	(0.16)	(0.19)	(0.25)	(0.25)	(0.29)	(0.35)

Table 3-2 (continued)

Distinguished foreign med. school	0.15	0.07	0.02	0.23	0.23	0.17	0.02
	(0.35)	(0.35)	(0.40)	(0.54)	(0.54)	(0.24)	(0.16)
"Third World" FMG	0.12	-0.04	0.04	0.29	0.43	0.44	0.10
	(0.20)	(0.19)	(0.22)	(0.29)	(0.29)	(0.33)	(0.30)
Other FMG	-0.10	-0.21	0.15	-0.24	-0.24	0.79	0.02
	(0.39)	(0.39)	(0.49)	(0.62)	(0.62)	(0.81)	(0.14)
Less than 10 years experience	0.33	0.35	0.41^c	0.23	0.24	0.30	0.06
	(0.23)	(0.23)	(0.25)	(0.33)	(0.33)	(0.37)	(0.24)
More than 35 years experience	-0.40^a	-0.72^a	-0.32^c	-0.60^a	-1.04^a	-0.53^c	0.18
	(0.15)	(0.15)	(0.18)	(0.23)	(0.24)	(0.28)	(0.38)
Affiliated with med. school hospital	0.62^a	-0.48^a	0.72^a	0.63^a	-0.81^a	1.01^a	0.33
	(0.13)	(0.20)	(0.16)	(0.19)	(0.29)	(0.23)	(0.47)
Affiliated with ltd. teaching hospital	0.76^a	0.83^a	0.43	1.76^a	1.96^a	1.92^a	0.06
	(0.23)	(0.24)	(0.28)	(0.35)	(0.35)	(0.42)	(0.24)
No primary hospital affiliation	0.82^a	0.70^b	0.95^b	3.09^a	2.92^a	3.35^a	0.03
	(0.34)	(0.34)	(0.42)	(0.99)	(0.99)	(1.26)	(0.17)
Incorporated, $\geq$ 6 MDs in practice	0.33	0.37	0.28	0.18	0.35	0.54	0.03
	(0.34)	(0.34)	(0.37)	(0.51)	(0.50)	(0.55)	(0.16)
Incorporated, 2 to 5 MDs in practice	0.39^a	0.43^a	0.51^a	0.65^a	0.73^a	0.67^a	0.23
	(0.15)	(0.15)	(0.17)	(0.22)	(0.22)	(0.25)	(0.42)
Incorporated, solo	0.49^a	0.52^a	0.42^a	1.24^a	1.31^a	1.04^a	0.22
	(0.15)	(0.15)	(0.17)	(0.22)	(0.22)	(0.26)	(0.41)
Unincorporated, $\geq$ 2 MDs in practice	0.08	0.14	0.02	0.20	0.28	0.28	0.10
	(0.19)	(0.19)	(0.22)	(0.29)	(0.28)	(0.32)	(0.30)
Female MD	0.06	0.06	-0.18	-0.05	0.05	-0.04	0.06
	(0.23)	(0.23)	(0.27)	(0.35)	(0.35)	(0.40)	(0.23)
Area Product Demand							
Physicians per 10,000 population	-0.024^a	-0.034^a	-0.011	-0.031^a	-0.057^a	-0.010	18.3
	(0.006)	(0.006)	(0.007)	(0.009)	(0.010)	(0.011)	(13.3)
Per capita income	0.0002^b	-0.0000	0.0002^b	0.0004^a	-0.0000	0.0002^c	6286.
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(1035.)
Population per square mile	0.011^a	0.010^a	0.010^a	0.011^a	0.011^a	0.012^a	28.6
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(87.1)
Percent private insurance	--	0.014^a	--	--	0.010^b	--	d
	(--)	(0.004)	(--)	(--)	(0.005)	(--)	
Percent Medicare	--	0.021^a	--	--	0.008	--	d
	(--)	(0.004)	(--)	(--)	(0.007)	(--)	
Percent Medicaid	--	-0.41^a	--	--	-0.67^a	--	d
	(--)	(0.07)	(--)	(--)	(0.10)	(--)	

Table 3-2 (continued)

Weighted fee schedule	0.29[a] (0.03)	-- (--)	-- (--)	0.26[a] (0.04)	-- (--)	-- (--)	d
Private insurance fee schedule	-- (--)	-- (--)	0.11[b] (0.05)	-- (--)	-- (--)	0.11[a] (0.04)	d
Medicare fee schedule	-- (--)	-- (--)	0.30[a] (0.06)	-- (--)	-- (--)	0.14[a] (0.06)	d
Medicaid fee schedule	-- (--)	-- (--)	2.24[a] (0.32)	-- (--)	-- (--)	3.01[a] (0.39)	d
Factor Prices							
Hospital wage (weekly)	0.011[a] (0.002)	0.014[a] (0.002)	0.012[a] (0.002)	0.014[a] (0.003)	0.016[a] (0.002)	0.014[a] (0.004)	184. (32.)
Rent (annual)	0.0008[a] (0.0002)	0.0010[a] (0.0002)	0.0010[a] (0.0002)	0.0011[a] (0.0003)	0.0014[a] (0.0003)	0.0014[a] (0.0002)	2261. (479.)
Malpractice premium (annual)	0.0003[a] (0.00002)	0.0004[a] (0.00002)	0.0002[a] (0.00002)	0.0004[a] (0.00002)	0.0004[a] (0.00003)	0.0003[a] (0.00004)	3385. (3804.)
Constant	4.66 (--)	11.79 (--)	1.91 (--)	3.76 (--)	17.50 (--)	0.77 (--)	-- (--)
	R^2= 0.31 F(36,5804) =71.8	R^2=0.31 F(38,5829) =67.7	R^2=0.30 F(38,3963) =43.8	R^2=0.19 F(36,4769) =30.3	R^2=0.19 F(38,4773) =28.7	R^2=0.18 F(38,3304) =18.9	

Notes:
a = Statistically significant at the one percent level (two-tailed test).
b = Statistically significant at the five percent level (two-tailed test).
c = Statistically significant at the 10 percent level (two-tailed test).
d = See Table 3-5 for means and elasticities of insurance variables.

Table 3-3: Other Fee Regressions

Explanatory Variable	Dependent Variables				
	7.EKG	8.PRC	9.GBL	10.HRN	11.DAC
Specialty					
Internal medicine	-0.95	--	--	--	--
	(0.63)	(--)	(--)	(--)	(--)
Other Physician and Practice Characteristics					
Board certified	-0.31	0.89	-0.04	-0.30	-4.38
	(0.53)	(0.71)	(10.76)	(7.08)	(3.87)
Distinguished U.S. med. school	-0.54	-1.15	6.52	10.36	1.31
	(0.63)	(0.87)	(12.62)	(8.31)	(4.66)
Undistinguished U.S. med. school	0.05	-1.59	18.66	12.59	2.06
	(0.79)	(1.08)	(14.66)	(9.63)	(5.11)
Foreign med. school (all FMGs combined)	0.97	0.003	13.94	-5.08	0.64
	(0.75)	(1.04)	(14.79)	(9.73)	(5.19)
Less than 10 years experience	0.47	2.35[c]	42.57	12.72	5.32
	(1.03)	(1.37)	(26.14)	(17.13)	(8.07)
More than 35 years experience	-0.32	-0.45	-33.37[b]	-24.31[a]	-6.42
	(0.68)	(0.98)	(13.22)	(8.70)	(5.62)
Affiliated with med.school hospital	-1.01[c]	0.69	-15.82	2.33	2.69
	(0.55)	(0.77)	(11.63)	(7.66)	(3.84)
Affiliated with limited teaching hospital	-0.74	0.37	28.96	25.56[c]	10.52
	(1.01)	(1.56)	(21.51)	(14.26)	(7.41)
Incorporated, $\geq$ 2 MDs in practice	-0.23	1.02	51.12[a]	31.13[a]	3.62
	(0.66)	(0.90)	(12.80)	(8.48)	(4.35)
Incorporated, solo	0.49	2.56[a]	33.38[a]	21.41[a]	5.83
	(0.64)	(0.90)	(12.50)	(8.20)	(5.12)
Unincorporated, $\geq$ 2 MDs in practice	0.16	0.35	14.08	10.50	-5.42
	(0.93)	(1.16)	(17.53)	(11.55)	(6.35)
Area Product Demand					
Physicians in specialty per 10,000 population	-0.59[a]	-0.34	-14.23[b]	-14.01[a]	-0.52
	(0.15)	(0.23)	(6.44)	(4.24)	(3.45)
Per capita income	0.0010[a]	0.0005	0.013	0.015[a]	0.001
	(0.0003)	(0.0005)	(0.008)	(0.005)	(0.002)
Population per square mile	-0.0038	0.0073	0.34[a]	0.33[a]	0.13[a]
	(0.0038)	(0.005)	(0.09)	(0.06)	(0.03)
Weighted fee schedule	0.28[a]	0.24[b]	0.38[a]	0.29[a]	0.37[a]
	(0.06)	(0.10)	(0.06)	(0.06)	(0.06)
Factor Prices					
Hospital wage	0.046[a]	-0.0003	-0.097	0.082	0.060
	(0.009)	(0.014)	(0.18)	(0.12)	(0.064)
Rent	-0.0030[a]	0.0005	-0.002	-0.016	0.011[b]
	(0.0008)	(0.001)	(0.016)	(0.010)	(0.005)
Malpractice premium	0.0011[a]	0.0009[a]	0.018[a]	0.012[a]	0.0037[a]
	(0.0003)	(0.0003)	(0.001)	(0.001)	(0.0004)
Constant	10.18	14.09	257.13	146.92	70.89
	(--)	(--)	(--)	(--)	(--)
	R^2=0.19	R^2=0.10	R^2=0.39	R^2=0.40	R^2=0.22
	F(19,831) =10.1	F(18,479) =2.9	F(18,737) =26.1	F(18,730) =26.9	F(18,910) =14.2

ferences in formal medical training that seem to matter to medical educators and some prospective medical students. The insignificant coefficients for "third world" foreign medical school graduate are somewhat surprising in view of past research by this author and others which suggests differences in physician behavior between third world FMGs and other physicians. One unique feature of this empirical analysis of physicians' fees is the inclusion of a lengthy list of variables describing physician credentials. These variables make a much smaller contribution to explained variance than we could have thought before undertaking this study.

Judging from both Tables 3-2 and 3-3, physicians with less than 10 years experience after obtaining the MD degree charge at least as much as their colleagues with 10 to 35 years experience and more than those with more than 35 years experience. This pattern may reflect a combination of factors. First, there may be a vintage effect; medical training may now be more technologically sophisticated, and young physicians may be able to command higher fees accordingly. This explanation is somewhat unlikely in view of the poor performance of the medical school variables above. Second, under usual-customary-reasonable (UCR) reimbursement, physicians have an incentive to set a high usual fee. Younger physicians recognize this but their older counterparts may be locked into low fee profiles that either pre-date UCR or the doctors' realization of the way UCR reimbursement systems operate. Third, younger physicians may be more profit-oriented and charge profit-maximizing fees. This is an ex post explanation in the sense that one could have attributed the same to older physicians if their fees were higher. Fourth, on-the-job training by physicians is not valued by patients, perhaps rightly, perhaps wrongly. Of the four potential explanations, the third is the least compelling.

No consistent pattern is evident with regard to the physician's primary hospital affiliation. Table 3-2's results suggest that affiliation with a teaching hospital enables doctors to charge higher fees, but this result is not replicated by Table 3-3 regressions. The negative coefficients on affiliation with medical school hospital in the second and fifth Table 3-2 regressions are attributable to multicollinearity with the predicted Medicaid percentage variable. No hospital affiliation, surprisingly, is associated with higher instead of lower fees. It is possible for a physician to have no primary hospital affiliation and still treat some patients in hospitals. For example, Table 3-2's fourth regressions contains 32 physicians who list no primary hospital affiliation but still list a hospital visit fee. Table 3-3 regressions omit this variable because of the small number of respondents with no such affiliation among those who perform the procedures listed in the table.

Incorporated physicians have higher fees on average than their unincorporated peers. At this point, this is only a descriptive fact -- the reason or reasons underlying this pattern are unknown. There are no price differences between female and male doctors, holding a large number of factors constant.

Both real per capita income and population density show positive and statistically significant effects in the majority of fee regressions. Considering only the positive per capita income coefficients, elasticities evaluated at the observational means vary from 0.03 to 0.25 with the central tendency between 0.08 and 0.15. The positive population density elasticities are all around 0.02. An 0.02 elasticity seems low, but this is somewhat misleading for a variable with a standard deviation over three times the mean. For example, raising the county population density to 200 persons per square mile in the county (not the highest density county) from the sample mean of 28.6 implies an increase in the office visit fee of $2.23, 15 percent higher than the sample mean of $14.42. Readers should bear in mind that all variables expressed in monetary terms have been deflated by an area cost-of-living index.

The physician-population ratio coefficients in Tables 3-2 and 3-3 are uniformly negative and the majority of associated coefficients are statistically significant at conventional levels. Table 3-4 presents estimated physician availability elasticities. Those based on the actual county physician-population ratio use parameter estimates from Tables 3-2 and 3-3. The other elasticities rely on parameter estimates not presented.

Elasticities evaluated at the observational means are low--in the 0.00 to -0.10 range. As with population density, a low elasticity is somewhat misleading in view of the high variance in county physician-population ratios. As seen in Table 3-4, alternative measures of physician availability have been included in fee regressions yielding approximately the same results. The use of a predicted physician-population ratio variable based exclusively on non-pecuniary measures of attractiveness of the area rules out one major source of simultaneous equations bias--namely, the possibility that physicians move to high fee areas at the same time physician availability influences fees. Specification of an SMSA-specific physician-population ratio with the county ratio for nonmetropolitan counties was an attempt to circumvent the border-crossing problem--the tendency for residents in areas with few physicians to obtain physicians' services in areas well-endowed with physicians. Clearly, this alternative ratio makes little difference either. This third ratio does not capture bordercrossing from beyond the fringes of the city. To the extent that patients travel long distances to see physicians, the estimated parameter on the physician-population ratio is biased toward zero, and the associated elasticities are understated. We cannot exclude this possibility. However, it is worth emphasizing that when one deflates for differences in area prices, includes a large number of explanatory variables which are justifiable on conceptual and institutional grounds, and estimates regressions based on a full equation specification, parameter estimates on the physician-population ratio are uni-

Table 3-4: Physician Availability Elasticities: Fees

		Ratio Definition	
Procedure	MDs per 10,000 county population	Predicted MDs per 10,000 county population	MDs per 10,000 pop: SMSA-county specification
Followup office visit (FOV)	-0.44[a]		
Followup offive visit (FOV)		-0.042[a]	
Followup office visit (FOV)			-0.003
Followup hospital visit (FHV)	-0.063[a]		
Followup hospital visit (FHV)		-0.043[a]	
Followup hospital visit (FHV)			-0.020
Electrocardiogram (EKG)	-0.085[a]		
Proctoscope exam (PRC)	-0.037		
Gall bladder removal (GBL)	-0.036[b]		
Hernia repair (HRN)	-0.056[a]		
Diagnostic D and C (DAC)	-0.003		

Notes:

a. Based on a parameter estimate statistically significant at the one percent level (two-tailed test).

b. Based on a parameter estimate statistically significant at the five percent level (two-tailed test).

formly negative. This finding stands in sharp contrast with a number of earlier studies based on a more limited specification which have reported that greater physician availability in an area is responsible for higher fees.[7] This study's findings provide no support for the target income/induced demand theories of physician economic behavior.

Taken as a whole, the insurance coefficients clearly establish a link between insurance and fees. The weighted fee schedule coefficients in Tables 3-2 and 3-3 are all positive and statistically significant at the five percent level or better. Varying only between 0.24 and 0.38, these coefficients are quite stable. They imply that if the mean fee schedule of insured patients (about 91 percent of the U.S. population visiting office-based doctors according to the two HCFA-NORC surveys) rose by $1.00, usual fees would rise from $0.22 (=0.24*0.91) to $0.35 (0.38*0.91) on average. Associated elasticities, evaluated at the means and shown in Table 3-5, vary from 0.13 for the follow-up office visit fee to 0.29 for gall bladder removal fee. The elasticities vary substantially more than the coefficients because of procedure-specific differences in the ratio of the mean fee schedule to the mean fee. In this instance, the coefficients are more easily interpreted than their elasticity counterparts.

The second and fifth regressions in Table 3-3 are based on the second insurance variable specification where insurance variables appear as percentages. The parameter estimates imply that as the percentage of patients with private insurance rises, so does the physician's usual fee. For example, an increase from no privately insured patients to 100 percent with private insurance would raise the usual hospital visit fee by $1.00; the corresponding impact on the office visit fee would be $1.40. The percentage of Medicare patients has a positive and statistically significant impact on the usual office visit fee, but none on the

Table 3-5: Insurance Elasticities: Fees

Table Number	Procedure (Regression No.[a])	Insurance Variable Means		Insurance Coefficient	Insurance Elasticity
3-3	Office visit (1)	WFS	$6.39	0.29	0.13
3-3	Office visit (2)	% Private Ins.[b]	57.4	0.014	0.06
		% Medicare	24.8	0.021	0.04
		% Medicaid	8.9	-0.41	-0.25
		% with insurance	91.1		
3-3	Office visit (3)[c]	Private ins. FS	$3.44	0.11	0.03
		Medicare FS	1.58	0.30	0.03
		Medicaid FS	1.10	2.24	0.18
			$6.12		
3-3	Hospital visit (4)	WFS	$11.04	0.26	0.18
3-3	Hospital visit (5)	% Private ins.	55.8	0.010	0.03
		% Medicare	25.2	0.008	0.01
		% Medicaid	12.2	-0.67	-0.50
		% with insurance	93.2		
3-3	Hospital visit (6)[c]	Private ins. FS	$6.93	0.11	0.05
		Medicare FS	2.46	0.14	0.02
		Medicaid FS	1.17	3.01	0.57
			$10.56		
3-4	EKG (7)	WFS	$20.15	0.28	0.25
3-4	Proctoscope exam (8)	WFS	$20.53	0.24	0.19
3-4	Gall bladder removal (9)	WFS	$452.44	0.38	0.29
3-4	Hernia repair (10)	WFS	$288.01	0.29	0.22
3-4	Diagnostic D&C (11)	WFS	$139.42	0.37	0.26

Key: WFS = Weighted fee schedule
FS = Fee schedule
a = Regression number refers to regressions in Tables 3-2 and 3-3.
b = In the first and third specifications, the percentages are expressed as proportions (percentages divided by 100).
c = Sample limited to Medicaid-participating physicians (the majority of all physicians).

hospital fee. Since Medicare provides better coverage for care provided by physicians in the office than private insurers typically do, this result is not at all surprising.

The negative sign on the predicted Medicaid percentage coefficients in the second and fifth regressions in Table 3-2 is plausible, but its magnitude relative to the other insurance coefficients is not. Mean usual fees of physicians who do not participate in the Medicaid program are higher than for those who do. Within a small range of changes in Medicaid patient case loads, the coefficients are plausible, and the vast majority of physicians have small Medicaid caseloads. However, the coefficients yield nonsensical predicted usual fee effects for larger changes in the Medicaid patient percentage.

The third insurance specification is represented by the third and sixth regressions in Table 3-2. All insurance parameter estimates are positive and statistically significant at the five percent level or better. Although the signs are consistent with the theory presented above, the magnitude of the Medicaid parameter estimates are questionable relative to those for other insurance variables. The insurance coefficients from these two regressions permit the conclusion that the amount of Medicaid payment influences the physician's usual fee for those physicians who participate. Although, on average, Medicaid fee schedules are comparatively meager, as these schedules increase physicians' usual fees increase as well. Recently, in response to budgetary "crises," some states have reduced Medicaid fee schedules across the board. Not only is such a policy likely to have an adverse effect on the number of Medicaid patients physicians are willing to treat (Sloan, Cromwell, and Mitchell, 1978), but it also should have a beneficial effect on physician fee inflation. A tentative implication of this finding is that current efforts to restrain expenditures under Medicare and Medicaid using, for example, a "caps" approach may impede the rate of physicians' usual fees.

The most notable result on factor prices is the uniformly positive and statistically significant (at the one percent level) impact of (real) malpractice insurance premiums on (real) fees. All associated elasticities from Table 3-2 are slightly under 0.10; those based on Table 3-4 range from zero to 0.17. A 0.1 elasticity implies that a doubling of premiums would boost fees by 10 percent. This effect is hardly trivial in view of the dramatic growth of premiums during much of the 1970s.

The hospital wage coefficients are uniformly positive and statistically significant in Table 3-2; but, though positive in three out of five regressions in Table 3-3, only one hospital wage coefficient is statistically significant at conventional levels. Wage elasticities based on Table 3-2 parameter estimates range from 0.14 to 0.18; the elasticity for the one significant Table 3-3 coefficient is 0.38; the other positive coefficients, for hernia repair and diagnostic D and C, yield associated wage elasticities of 0.04 and 0.06, respectively. Hospital wages have not increased sufficiently in recent years to be a major source of physician fee inflation.[8]

The estimated annual office rent variable has positive and statistically significant impacts on fees in Table 3-2, but the Table 3-3 results on this variable must be considered mixed at best. Elasticities associated with positive and significant coefficients range from 0.13 to 0.19. Of the three factor price variables, the rent variable is the least well-measured; at least part of the poor performance of rent in Table 3-3 is properly attributed to unavoidable measurement error.

Combining the effects of all three factor price variables yields total factor price elasticities in the 0.1 to 0.2 range. As noted above, all monetarily-expressed variables have been deflated by an area cost-of-living deflator. Hence, if a particular factor price does not keep pace with the rise in prices in general, it contributes to a decline in real fees.

EMPIRICAL RESULTS ON LENGTH-OF-VISIT

One of the important questions that the fee analysis raises is the extent to which particular fee determinants also cause systematic changes in the nature of medical care supplied. It is relatively easy to analyze a homogenous good or service but, in a policy context, the assumption that certain variables, such as insurance coverage, affect price but not quality could lead to unfortunate policy actions. If higher fees are, in fact, associated with higher quality, there is less reason for concern than if observed fee increases truly reflect increases in quality-adjusted prices.

A difficulty with quality is its multidimensional nature. Even if one has assessed sources of variation in a number of dimensions, one can always find others. As discussed in Chapter 2, quality should be defined to encompass "amenities" associated with delivery of care as well as medical or technical elements.

Length-of-visit is an important dimension of quality. The HCFA-NORC surveys allows one to develop an indirect measure of length-of-visit. Data are available on patient-care work hours in several activities: in the office, on hospital rounds, in hospital emergency rooms and out-patient clinics, in surgery, and so on. Data are also available on the number of office visits, in-patient visits (not counting surgery, surgical assists, or emergency room and out-patient visits), surgical procedures, emergency and out-patient visits, and so on. Hours and visit questions refer to the physician's last week prior to being surveyed.

Using these data, estimates of length-of-visit for office and hospital rounds have been derived by dividing physician time in office and hospital visits expressed in total weekly minutes by the weekly number of visits in each of the two activities. Eliminating extreme values (length-of-visit under two or over 45 minutes), the mean lengths-of-visit for office and hospital are 19.8 and 21.7 minutes, respectively.

The HCFA-NORC surveys asked the physician to list time spent consulting with other physicians, writing, in research, lecturing, in medical meetings, and travelling to patient care settings. Hence, time spent in such non-direct patient-care functions should not be reflected in the length-of-visit estimates. However, time spent filling out insurance forms and medical records and some administrative time is undoubtedly part of these estimates. For this reason, the estimates appear somewhat higher than those for the office based on the U.S. National Center for Health Statistics' National Ambulatory Care Survey[9] but they are very close to estimates for the office and hospital from the American Medical Association's surveys of physicians.[10]

Length-of-visit regressions for office and hospital visits are presented in Table 3-6. Much could be said about these regressions, but the discussion here is confined to key results that affect the way one interprets the fee results in the earlier tables.

There are clearly major differences in length-of-visit for office and hospital visits among specialties. In general, hospital visits by surgical specialists are short; hence, it is not surprising that low or negative coefficients on surgical specialty variables were obtained in Table 3-2 fee regressions. Estimated length-of hospital visit is relatively lengthy in fields which depend relatively little on hospital work, for example, allergy and dermatology. As with fees, the medical school variables reveal only minor differences in visit length; an exception is length of hospital visit for "third-world FMGs," a factor that may explain the absence of fee differences in the hospital visit in Table 3-2. Physicians with more than 35 years experience take more time per visit in the office, but there is no discernable difference in hospital work. Relatively high fees of young doctors cannot be explained on the basis of length-of-visit. Unincorporated solo

Table 3-6: Length-of-Visit Regressions

Explanatory Variables	Length-of-Visit Office	 Hospital
Specialty		
Allergy	1.97[a]	9.01[a]
	(0.77)	(1.48)
Cardiovascular disease	9.81[a]	1.85
	(0.87)	(1.29)
Dermatology	-3.46[a]	10.02[a]
	(0.78)	(1.70)
Gastroenterology	11.65[a]	1.74
	(0.93)	(1.40)
General surgery	1.84[a]	-4.67
	(0.58)	(0.95)
Internal medicine	6.62[a]	0.15
	(0.55)	(0.82)
Neurological surgery	11.68[a]	-1.77
	(0.86)	(1.25)
Obstetrics-gynecology	0.50	-3.33[a]
	(0.59)	(1.02)
Ophthalmology	2.49[a]	1.81
	(0.75)	(1.50)
Orthopedic surgery	0.68	-6.46[a]
	(0.79)	(1.27)
Otolaryngology	-0.43	0.24
	(0.74)	(1.36)
Pediatrics-pediatric surgery	0.24	3.38[a]
	(0.50)	(0.80)
Urology	2.75[a]	-1.38
	(0.82)	(1.26)
Other Physician and Practice Characteristics		
Board certified	-0.12	0.31
	(0.29)	(0.48)
Distinguished U.S. medical school	0.22	-0.40
	(0.34)	(0.57)
Undistinguished U.S. medical school	-0.07	0.26
	(0.40)	(0.67)
Distinguished foreign medical school	0.89	0.50
	(0.85)	(1.50)
"Third World" FMG	0.56	2.21[a]
	(0.48)	(0.81)
Other FMG	-1.38	1.90
	(0.99)	(1.69)
Less than 10 years experience	0.71	0.46
	(0.55)	(0.88)
More than 35 years experience	1.31[a]	0.57
	(0.37)	(0.64)

Table 3-6 (continued)

Explanatory Variables	Length-of-Visit Office	 Hospital
Affiliated with medical school hospital	0.82[b]	1.86[a]
	(0.31)	(0.50)
Affiliated with limited teaching hospital	0.78	-0.53
	(0.58)	(0.98)
No primary hospital affiliation	2.99[a]	3.26
	(0.86)	(3.27)
Incorporated, ≥ 6 MDs in practice	-1.73[b]	-4.32[a]
	(0.83)	(1.34)
Incorporated, 2 to 5 MDs in practice	-4.17[a]	-5.47[a]
	(0.36)	(0.58)
Incorporated, solo	-3.60[a]	-2.64[a]
	(0.36)	(0.60)
Unincorporated, ≥ 2 MDs in practice	-1.95[a]	-3.88[a]
	(0.48)	(0.77)
Female MD	0.93	2.29[b]
	(0.57)	(0.97)
Area Product Demand		
Physicians per 10,000 population	0.018	0.073[a]
	(0.015)	(0.025)
Per capita income	-0.00003	0.0002
	(0.0002)	(0.0003)
Population per square mile	0.0059[a]	0.0002
	(0.0023)	(0.004)
Weighted fee schedule	0.20[b]	-0.077
	(0.09)	(0.096)
Factor Prices		
Hospital wage (weekly)	0.-016	-0.0006
	(0.005)	(0.008)
Rent (annual)	0.0013[a]	0.0020[a]
	(0.0004)	(0.0007)
Malpractice premium (annual)	0.00019[a]	0.00035[a]
	(0.00005)	(0.00008)
Constant	(--)	(--)
	R^2= 0.16 F(36,5488) = 30.0	R^2= 0.11 F(36,3891) =12.7

Notes:

a = Statistically significant at the one percent level (two-tailed test).
b = Statistically significant at the five percent level (two tailed test)

physicians, the omitted reference category, have significantly longer visits than their incorporated colleagues and than physicians practicing in unincorporated partnerships or groups. This could reflect efficiency differences as well as differences in styles of care. Fees of solo unincorporated doctors fees are comparatively low, even without taking length-of-visit into account. Results from Table 3-6 make them appear even lower. Holding other factors constant, female physicians spend more time per visit than their male peers although, as seen in in earlier tables, their fees are much the same.

The product demand variables of primary interest are the county physician-population ratio and the weighted fee schedule. Although both physician-population ratio coefficients have positive signs, only the one for hospital visits attains statistical significance at conventional levels. Associated elasticities evaluated at the observational means are 0.02 and 0.06, respectively. This effect is not large, but it suggests that quality-adjusted fees may be more sensitive to changes in physician availability than fees unadjusted for quality.

Insurance (the weighted fee schedule) has a positive and significant impact only in the office length-of-visit regression. In this case, the associated elasticity is 0.06. Thus, the effect of insurance on qualitative dimensions of physicians' services remains unclear. There is evidence from prior research (Sloan and Lorant, 1977) that where major medical insurance is prelevent, patient visits in physicians' offices tend to be relatively short; the opposite pattern was reported in the same study for Medicare, but this latter result may reflect relatively low opportunity cost of time of persons of age 65 and over. A more recent study (Guterman, et al., 1980) reported that the percentage of state population under 65 with medical insurance had no impacts on the length of visit or the office wait, but found that a higher percentage of patients in the Primary Sampling Unit covered by Medicaid leads to longer waits in the office, shorter visits, and fewer telephone consul-

tations per visit; in that study, a higher percentage of private medical insurance was reflected by increased physician telephone contacts with patients, an amenity patients presumably value. Empirical studies, including the present one, have only provided clues as to the effects of insurance on quality and hence on quality-adjusted prices. To say more will require linking a broad spectrum of quality measures with adequate measures of insurance coverage and levels of payment. Obtaining such data merits a high priority.

SUMMARY AND CONCLUSIONS

Two types of potential fee determinants have commanded a great deal of interest both in academic and in policy circles: physician availability and insurance for physicians' services. The HCFA-NORC surveys provide the basis for more in-depth empirical analysis on the effects of these and other variables on physicians' fees than was possible heretofore.

Three alternative measures of physician availability have been used in this chapter. All three imply that physician availability has either a negative or a zero impact on fees. The notion that greater physician availability leads to higher fees receives no support in this chapter. The empirical analysis represents a substantial improvement over past efforts in this area because equation specification is more complete and a much larger number of procedures and specialties are considered.

At the same time, it should be emphasized that the physician availability elasticities are low; all estimates presented in the chapter are between zero and -0.1. When population density is eliminated as an explanatory variable in regressions not presented, the physician availability elasticities rise, but are never more negative than -0.2. Hence, although statistically significant estimates of physician availability are often obtained, increasing physician supply should certainly not be seen as a key element in a policy directed at reducing the rate of physician fee inflation.

To both policymakers and to economists who base predictions of physicians' responses on the standard model of the firm, it is logical that generous third party reimbursement should be a source of inflation in physicians' fees. Primarily because of data limitations, much of the empirical evidence on the health insurance-physician fee nexus has been conflicting. This chapter confirms policymakers' intuition and predictions from economic modelling. Moreover, using the weighted fee schedule estimates in particular, there are now, for the first time, reasonably reliable estimates of fee responses to variations in the generosity of third party reimbursement. Taken as a whole, the weighted fee schedule elasticities imply that a 10 percent increase in insurer payment levels for a procedure leads to about a two percent increase in the price of that procedure.

One of the important questions that remains is the extent to which insurance changes the nature of medical care--its "quality," which we have defined to include amenities associated with patient care services. This chapter has investiaged one dimension of quality, the length of time physicians spend with patients on office and hospital visits. Results with regard to the effect of insurance on length-of-visit are inconclusive. Since only two procedures have been considered and length-of-visit is only one dimension of quality in any event, very little importance should be attached to our failure to detect a uniformly positive and statistically significant effect of insurance on length-of-visit in this chapter.

The small role played by physicians' credentials as fee determinants comes as a surprise, although credentials are far better represented here than in previous fee studies. Whether or not credentials variables are included seems to make little difference. There are important differences in fee levels for given procedures among specialties and by incorporation status, however. The reason incorporation matters is not currently well understood.

Input prices paid by physicians do affect fees. The findings suggest that a 10 percent increase in input prices relative to the overall cost-of-living would raise fees by about one percent relative to the cost-of-living. Input prices are one of several influences on fees rather than a dominant force.

FOOTNOTES TO CHAPTER 3

[1] These are the main reasons for loss of cases: (1) questions were designed in a specialty-specific manner and the sample sizes for some specialties are small; (2) questions were placed toward the end of the interview and some interviews were not completed; (3) there are some changes in procedure definition between 1977-78; (4) some physicians did not perform the procedures listed for their specialty; and (5) some respondents simply could not recall information on third party payments for specific procedures.

[2] This deflator is described at length in Sloan and Steinwald (1980b).

[3] Separate Medicaid regressions have been estimated for (1) a binary variable which takes the value of one if the doctor accepts Medicaid patients, and (2) the Medicaid patient proportions of those physicians who do accept Medicaid patients. The predicted Medicaid proportion variable is the product of the predicted values from both regressions.

[4] See Part IV of this report for additional discussion of determinants of insurance coverage for physicians' services.

[5] See Sloan, Cromwell, and Mitchell (1978).

[6] The data are described in greater detail in Chapter 5. The author thanks Benson Dutton and Nancy Greenspan of HCFA for making these data available.

[7] See, for example, Newhouse (1970) and Dyckman (1978).

[8] See, for example, Sloan and Steinwald (1980a).

[9] U.S. Department of Health, Education, and Welfare (1980), p. 190.

[10] Sloan and Lorant (1977).

Chapter 4

Physicians' Incomes and Workloads

Frank A. Sloan

INTRODUCTION

This chapter presents our empirical analysis of physicians' incomes and workloads, measured by the total number of visits. Income is for the year preceeding the HCFA-NORC Survey and visits are reported for the week immediately preceeding the Survey. As in Chapter 3, the surveys for 1977 and 1978 have been combined into a single data file. Thus, incomes are for 1976 and 1977 and visits for 1977 and 1978. The empirical specification is identical to Chapter 3's with the exception of a few additional explanatory variables described below. Unlike the fee equations, which were expressed in linear form, all continuous variables in the income and visit equations enter in natural log form and all binary variables enter in linear form. Use of logarithms in analysis of incomes has become a convention in economics.

The next section provides descriptive evidence on physicians' incomes. The ensuing three sections present regressions on gross income, net income, and total visits, respectively. Summary and conclusions are found in the concluding section.

DESCRIPTIVE EVIDENCE

The HCFA-NORC Surveys requested an unusual amount of information on physicians' incomes. Whereas data on gross and net incomes of physicians have been available from a number of sources, deferred income information has not. This latter kind of information is difficult to obtain, and the two surveys have done so only imperfectly.

Table 4-1 presents tabulations on five income measures: gross; net; total net; net per patient care hour; and deferred. Although total net income is defined to equal net plus deferred income, the total net in the table clearly exceeds the sum

Table 4-1: Income by Corporate Status and Practice Size

	All	Incorporated			Unincorporated		
		≥6MDs	2-5MDS	Solo	≥6MDs	2-5MDs	Solo
Gross income	$128,494.	136,009.	145,723.	148,244.	111,056.	105,323.	114,633.
Net income	$ 58,082.	75,956.	72,721.	63,077.	76,493.	62,725.	47,111.
Total net income	$ 77,148.	92,044.	94,785.	84,221.	97,153.	77,875.	60,482.
Net income per hour	$ 27.14	35.09	32.48	28.77	31.98	28.24	23.29
Deferred income	$ 5,543.	2,109.	5,533.	13,328.	717.	1,644.	3,349.

Source: 1977 and 1978 HCFA-NORC Surveys. Estimates combine information from both surveys. Figures are in 1976 dollars.

of the two components. This discrepancy is due to the fact that a large number of physicians failed to respond to the deferred income question. Those who did respond had higher than average net incomes, and total net income can only be computed when the physician provided both net and deferred income information. All values in the table have been deflated by an area cost-of-living index and are in 1976 dollars. In the case of practices with more than one physician, estimates of gross and deferred income have been obtained by dividing a practice-specific income variable by the number of full-time equivalent physicians in the practice.

Table 4-1 also provides income information by corporate status and practice size. Incomes of incorporated physicians are far higher than those of unincorporated physicians. In general, income rises with practice size, but the corporate status variable provides greater contrasts in physicians' incomes than does practice size. Patterns evident in Table 4-1 are at best suggestive, however, since other factors may be correlated with corporate status and/or size and in fact may be responsible for these relationships.

Table 4-2 compares estimates of mean net physician income from the HCFA-NORC Surveys with income estimates from American Medical Assocation and Medical Economics surveys. To establish comparability with the two income estimates from the other two sources, a cost-of-living deflator has not been used at all for this table. Moreover, separate mean net income estimates from the HCFA-NORC surveys for 1976 and 1977 are presented. The income regressions do not use the weights supplied by HCFA-NORC files. Table 4-2 shows mean net income, both weighted and unweighted.

Two features about Table 4-2 are noteworthy. First, income estimates from three sources, HCFA-NORC, AMA, and Medical Economics, are reasonable close. The weighted HCFA-NORC estimates are slightly lower than the others. Second, the weighted estimates are about four percent lower than their unweighted counterparts.

Table 4-2: Comparisons of Net Physician Income Levels: Alternative Data Sources

Source	Year	Amount ('000s)
HCFA-NORC (A)[a]	1976	$57.8
HCFA-NORC (B)[a]	1976	60.3
AMA[b]	1976	59.5
Medical Economics[c]	1976	62.6
HCFA-NORC (A)[a]	1977	61.0
HCFA-NORC (B)[a]	1977	63.6
AMA[b]	1977	61.2
Medical Economics[c]	1977	63.9

Notes:

a = HCFA-NORC Surveys: (A) is weighted to achieve a nationally representative sample; HCFA-NORC (B) is unweighted and, in this sense, more comparable to income data from the other sources.

b = Source: Glandon and Shapiro (1980), p. 40.

c = Source: U.S. Department of Commerce (1980), p 109. *Medical Economics* presents separate estimates for unincorporated and incorporated physicians. A combined estimate was obtained by weighing incorporated and unincorporated physicians by 0.438 and 0.562, respectively. These proportions are based on the HCFA-NORC surveys.

These are not great discrepancies. Item non-response, for which no weights are available, is likely to be a more serious problem.[1]

EMPIRICAL RESULTS: GROSS PHYSICIAN INCOME

Table 4-3 presents two gross income regressions. The first is limited to solo practitioners, either unincorporated or incorporated; the second includes physicians in all practice size-corporate status categories. As noted above, gross income per physician is defined for the practice as a whole. Especially for multispecialty groups, including measures of characteristics of one physician member to describe the practice as a whole would be misleading. Hence, physician (as opposed to practice-specific) variables have been omitted from the second regression which includes data from practices with more than one physician. Restricting the sample to solo practitioners results in a loss of about 1,900 observations. As seen in Table 4-3, although the second regression includes many fewer explanatory variables, the explained variation is almost as high, with an R^2 of 0.13 versus 0.16 for the first regression. Variables describing the physician's primary hospital affiliation have been included on the assumption that physicians within a partnership or group are likely to rely on the same hospital facilities for reasons of location as well as taste and a reasonably common background.

The general form of the gross income and other regressions presented in this chapter is

$$\ln Y = a + \sum_i b_i \ln X_i + \sum_j c_j Z_j + \sum_m d_m D_m \qquad (4\text{-}1)$$

where the X_i and Z_i represent continuous variables and the D_j binary variables. The b_i coefficients are directly interpretable as elasticities. The coefficient of a continuous variable entered in linear form, the Z_j, is

$$c_j = \frac{\partial \ln Y}{\partial Z_j} = \frac{1}{Y} \cdot \frac{\partial Y}{\partial Z_j} \qquad (4\text{-}2).$$

Multiplied by 100, c_j yields the percentage change in Y resulting from a change in Z_j. The elasticity is $c_j Z_j$.

Table 4-3: Income and Workload Regressions

Explanatory Variable	Dependent Variable						
	1.GRY*	2.GRY	3.NTY	4.NTY	5.TNTY	6.NTYH	7.TVIS
Specialty*							
Allergy	0.24^{a}	--	0.12^{a}	-0.02	0.16^{a}	0.30^{a}	0.09^{b}
	(0.04)	(--)	(0.03)	(0.04)	(0.04)	(0.14)	(0.04)
Cardiovascular disease	0.13^{b}	--	0.20^{a}	0.07	0.22^{a}	0.20^{a}	-0.10^{b}
	(0.06)	(--)	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)
Dermatology	0.12^{a}	--	0.20^{a}	0.14^{a}	0.18^{a}	0.37^{a}	0.26^{a}
	(0.04)	(--)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Gastroenterology	0.12^{b}	--	0.13^{a}	0.07	0.15^{a}	0.15^{a}	-0.08^{c}
	(0.07)	(--)	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)
General surgery	0.16^{a}	--	0.20^{a}	0.20^{a}	0.24^{a}	0.11^{a}	0.17^{a}
	(0.04)	(--)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Internal medicine	0.02	--	0.03	0.03	0.03	0.00	-0.04
	(0.03)	(--)	(0102)	(0.02)	(0.04)	(0.03)	(0.03)
Neurological surgery	0.34^{a}	--	0.33^{a}	0.33^{a}	0.40^{a}	0.37^{a}	-0.07^{c}
	(0.06)	(--)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Obstetrics-gynecology	0.30^{a}	--	0.19^{a}	0.09^{a}	0.25^{a}	0.10^{a}	0.27^{a}
	(0.04)	(--)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Ophthalmology	0.18^{a}	--	0.16^{a}	0.19^{a}	0.22^{a}	0.28^{a}	-0.15^{a}
	(0.05)	(--)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
Orthopedic surgery	0.37^{a}	--	0.32^{a}	0.24^{a}	0.34^{a}	0.29^{a}	0.19^{a}
	(0.06)	(--)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Otolaryngology	0.24^{a}	--	0.16^{a}	0.19^{a}	0.25^{a}	0.21^{a}	0.20^{a}
	(0.05)	(--)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Pediatrics and pediatric surgery	0.05^{c}	--	-0.05^{b}	0.08^{a}	-0.04	-0.09^{a}	0.28^{a}
	(0.03)	(--)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)
Urology	0.12^{c}	--	0.19^{a}	0.18^{a}	0.23^{a}	0.21^{a}	0.11^{a}
	(0.06)	(--)	(0.04)	(0.02)	(0.04)	(0.04)	(0.04)
Other Physician and Practice Characteristics							
Board certified	0.01	--	0.04^{a}	-0.02^{b}	0.03	0.06^{a}	-0.03^{a}
	(0.02)	(--)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Distinguished U.S. med school	-0.04^{c}	--	-0.01	-0.02^{b}	-0.01	0.03	-0.02
	(0.02)	(--)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Undistinguished U.S. med school	-0.01	--	-0.00	-0.01	0.00	-0.02	-0.01
	(0.03)	(--)	(0.17)	(0.12)	(0.02)	(0.02)	(0.02)

Table 4-3: (continued)

Explanatory Variable	1.GRY*	2.GRY	3.NTY	4.NTY	5.TNTY	6.NTYH	7.TVIS
Distinguished foreign med. school	-0.05	--	-0.07^b	-0.07^b	-0.05	-0.03	-0.01
	(0.05)	(--)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
"Third World" foreign med. school	-0.10^a	--	-0.08^a	-0.08^a	-0.06^a	-0.07^a	-0.10^a
	(0.03)	(--)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Other foreign med. school	-0.13^b	--	-0.02	-0.03	0.02	-0.00	-0.03
	(0.06)	(--)	(0.04)	(0.04)	(0.06)	(0.05)	(0.05)
Less than 10 years experience	0.01	--	-0.06^a	-0.06^a	0.01	-0.03	-0.03
	(0.04)	(--)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
More than 35 years experience	0.02	--	-0.15^a	-0.17^a	-0.13^a	-0.10^a	0.06^a
	(0.02)	(--)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Incorporated, $\geq$ six MDs	--	0.20^a	0.34^a	0.35^a	0.36^a	0.30^a	0.12
	(--)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Incorporated, two to five MDs	--	0.25^a	0.32^a	0.32^a	0.35^a	0.23^a	0.21^a
	(--)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Incorporated, solo	0.29^a	0.30^a	0.22^a	0.22^a	0.27^a	0.13^a	0.14^a
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Unincorporated, $\geq$ two MDs	--	-0.007	0.28^a	0.29^a	0.26^a	0.13	0.16^a
	(--)	(0.025)	(0.02)	(0.02)	(0.03)	(0.12)	(0.02)
Female MD	0.10^a	--	-0.18^a	-0.18^a	-0.17^a	-0.11^a	-0.11^a
	(0.03)	(--)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Employed MD	--	--	-0.05	-0.04	--	-0.03	0.05
	(--)	(--)	(0.04)	(0.04)	(--)	(0.04)	(0.04)
All prepaid practice	--	-0.10	-0.17^c	-0.17^c	-0.10	-0.13	-0.14
	(--)	(0.11)	(0.09)	(0.09)	(0.10)	(0.10)	(0.10)
Characteristics of MD's Hospital*							
Affiliated with med. school hospital	-0.02	-0.004	-0.02^b	-0.10^a	-0.02	0.002	-0.08^a
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.002)	(0.01)
Affiliated with ltd. teaching hospital	-0.02	-0.04	-0.04^a	-0.03	-0.06^b	-0.06^b	-0.08^a
	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
No primary hospital affiliation	0.05	-0.02	-0.09^a	-0.13^a	-0.03	0.19^a	-0.04
	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Average cost per adjusted patient day in physician's hospital	0.00005	0.00003	0.0002^a	0.0002^a	0.0001	0.0007^a	-0.0009^a
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)

Table 4-3: (continued)

Explanatory Variable	1.GRY†	2.GRY	3.NTY	4.NTY	5.TNTY	6.NTYH	7.TVIS
Area Product Demand**							
Physicians per 10,000 population	-0.10[a]	-0.09[a]	-0.11[a]	-0.13[a]	-0.12[a]	-0.075[a]	-0.09[a]
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.015)	(0.001)
Per capita income	0.39[a]	0.45[a]	0.39[a]	0.20[a]	0.46[a]	0.33[a]	0.08
	(0.07)	(0.06)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)
Population per square mile	-0.03[a]	-0.03[a]	-0.02[a]	-0.02[a]	-0.02[a]	-0.01	--[d]
	(0.01)	(0.01)	(0.004)	(0.004)	(0.005)	(0.01)	(--)
Percent private insurance	0.0015[c]	0.0019[a]	0.0014[a]	0.0015[a]	0.0014[a]	0.0011[c]	0.0016[b]
	(0.0008)	(0.0006)	(0.0005)	(0.0004)	(0.0006)	(0.0006)	(0.0007)
Percent Medicare	0.0028[a]	0.0026[a]	0.0013[b]	0.0020[a]	0.0019[a]	0.0010	0.0042[a]
	(0.0009)	(0.0006)	(0.0006)	(0.0005)	(0.0007)	(0.0007)	(0.0007)
Percent Medicaid (actual)	0.0010	0.0002	-0.0000	--	-0.0002	-0.0012	0.0040[a]
	(0.0010)	(0.0008)	(0.0007)	(--)	(0.0009)	(0.0008)	(0.0009)
Percent Medicaid (predicted)	--	--	--	-0.039[a]	--	--	--
	(--)	(--)	(--)	(0.005)	(--)	(--)	(--)
Factor Prices							
Hospital wage (weekly)	0.23[a]	0.15[a]	0.12[a]	0.07[b]	0.13[a]	0.18[a]	-0.06
	(0.06)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Rent (annual)	-0.27[a]	-0.35[a]	-0.26[a]	-0.20[a]	-0.21[a]	-0.23[a]	-0.15[a]
	(0.06)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
Malpractice premium (annual)	0.03[a]	0.04[a]	-0.010	-0.039[a]	-0.011	-0.001	-0.01
	(0.01)	(0.01)	(0.009)	(0.005)	(0.011)	(0.01)	(0.01)
Constant	9.43	9.51	9.12	11.14	8.31	1.17	10.04
	(--)	(--)	(--)	(--)	(--)	(--)	(--)
	$R^2=0.16$	$R^2=0.13$	$R^2=0.28$	$R^2=0.28$	$R^2=0.34$	$R^2=0.18$	$R^2=0.15$
	F(36,4044) =29.9	F(18,5124) =50.5	F(41,5908) =55.1	F(41,5908) =57.2	F(40,3762) =47.5	F(41,5580) =30.7	F(40,5988) =26.9

Notes:

* all explanatory variables under heading enter linearly;

** last four variables under heading enter linearly;

a statistically significant at one percent level (two-tailed test);

b statistically significant at five percent level (two-tailed test);

c statistically significant at ten percent level (two-tailed test);

d this variable's F to enter is 0.008;

† solo practitioners only.

Key:

GRY = gross income; NTY = net income; TNTY = total net income; NTYH = net income per patient care hour; and TVIS = total visits.

As Halvorsen and Palmquist (1980) have recently shown, the percentage effect of a binary variable entered in the manner of D_m in equation (1) is

$$G = 100 \cdot \{\exp(d_m)-1\} \qquad (4\text{-}3),$$

where G is the percentage effect on the dependent variable when the binary variable D_m takes the value one relative to effect when D_m is zero. In Table 4-3, all "specialty" and "other physician and practice characteristics" variables are D_m-type variables as are three out of the four variables under "characteristics of the MD's hospital." The reimbursement variables are of the Z_j type. The remaining variables are continuous.

The specialty variables and other physician and practice characteristics variables (through physician experience) appear only in the gross income regression based on the solo practitioner sample. To illustrate the effect of performing the transformation given by equation (4-3), the first regression implies that, holding other factors constant, gross incomes of solo orthopedic surgeons are 45 percent higher than their general-family practitioner colleagues; this estimate is derived from the 0.37 coefficient for orthopedic surgeons in this regression. In general, with the exception of allergy, gross incomes of surgical specialists tend to be high relative to medical specialists. In fact, internist and pediatrician gross incomes are quite close to those of general-family practitioners. This type of information is widely available in tabular form, but Table 4-3 holds numerous other pertinent factors constant.

These are the most interesting features derived from the other physician characteristics coefficients: First, solo foreign medical school graduates' gross incomes are 11 percent or more lower than those of graduates of mid-range U.S. medical schools, the omitted reference category from the set of medical school variables. Second, there is no premium in terms of higher gross income for graduating from a distinguished U.S. medical school. Third, the experience-gross income curve is completely flat. The third finding suggests that practice building is not very difficult. An alternative explanation is that young doctors locate in high demand areas, but several key demand variables have been included in the regressions. This pattern is highly unusual relative to other occupations, such as law. Since the first regression pertains only to solo practitioners, the results on experience would not be altered by an internal income distribution scheme devised by a practice's partners that could adversely affect the young doctor.

Coefficients on corporate status-group size variables reveal that gross incomes per doctor are far higher in incorporated than in unincorporated practices. There is, for example, a 34 percent differential between incorporated and unincorporated solo practitioners. The reason for this differential cannot be determined with available information.

The female physician variable has a positive coefficient, but it is best to defer judgment until after net income results have been examined. Two characteristics variables not present in the fee analysis appear in Table 4-3: employed MD and all prepaid practice. The former only appears in net income regressions; in fact, responses from employed physicians have been excluded from the gross income regressions. The insignificant prepaid practice coefficient implies that gross income per doctor is about the same in fee-for-service as in prepaid practice.

None of the variables under the heading "characteristics of the MD's hospital" have a statistically significant effect on gross incomes. The first three variables were defined in Chapter 3; the variable "average cost per adjusted patient day in hospital" is new. High input intensity on the hospital side may raise physician productivity in his practice as Pauly (1980) has argued. However, if this is the case, the hypothesis receives no empirical support in Table 4-3. The parameter estimate on this variable is highly insignificant in both gross income regressions.

By contrast, virtually all product demand variables have significant impacts on the dependent variable. Coefficients on the first three variables are elasticities. Per capita income exerts a substantial impact on gross income with estimated elasticities of 0.39 and 0.45 in the first and second regressions, respectively.

Elasticities depicting the gross income response to changes in physician availability require additional explanation. As in the analysis of fees, three alternative physician-to-population ratios have been employed. Elasticities are presented in Table 4-4. As seen in that table, estimated elasticities are insensitive to the choice of ratio. The physician-population ratio is collinear with population density. With the latter variable excluded, estimated physician-population ratio elasticities rise, but they never more than double. The use of a predicted ratio based on the exogenous variables listed in Chapter 3 eliminates the possibility of simultaneous equations bias. But, as stated in the previous chapter, one cannot be sure that the patient border-crossing phenomenon has been, or can be, adequately dealt with. Border-crossing would bias the estimated elasticities toward zero. We cannot be sure that even the SMSA-county ratio eliminates the border-crossing phenomenon.

The regressions contain three insurance variables: the percentage of the physician's patients with private insurance, with Medicare, and with Medicaid. All parameter estimates are positive, and all except the Medicaid variables are statistically significant at conventional levels. Elasticities associated with the three insurance variables in the first regression are 0.09, 0.06 and 0.01; from the second, corresponding elasticities are 0.11, 0.06, 0.00. As expected, private insurance has the largest impact, followed by Medicare. Medicaid has no effect. A gross income regression with the predicted Medicaid variable is not presented in Table 4-3; the coefficient on the predicted variable is small and negative.

Table 4-4 : Physician Availability Elasticities: Income and Visits

Ratio Function	Dependent Variable				
	Gross Income*	Net Income	Total Net Income	Net Income Per Hour	Weighted Visits
MDs per 10,000 cty. population	-0.10[a]/-0.09[a]	-0.11[a]	-0.12[a]	0.07[a]	-0.09[a]
Predicted MDs per 10,000 cty. population	-0.04/-0.06[a]	-0.10[a]	-0.10[a]	-0.09[a]	-0.10[a]
MDs per 10,000 population: SMSA-cty. specification	-0.11[a]/-0.10[a]	-0.10[a]	-0.12[a]	-0.05[a]	-0.11[a]

Notes: [a] = Parameter estimate is statistically significant at one percent level (two-tailed test).
* = First elasticity based on sample of solo practitioners only.

Finally, the factor price coefficients (elasticities) for the hospital wage and malpractice premium are positive and statistically significant, implying that increases in wages and premiums relative to area prices are shifted forward in part to patients. However, the magnitude of effect is low, especially for malpractice premiums. The rent variable enters the gross income regressions negatively, certainly an implausible result. In part, the negative coefficient reflects multicollinearity with the other two factor prices. More interesting than individual elasticities is the combined effect of all three factor prices on gross physician income. Using weights on physician expenditure on non-physician inputs for 1978 from Table 1 (0.639, 0.233, and 0.128 for non-physician labor, office space, and malpractice insurance premiums, respectively), the overall factor price elasticities for the first and second regressions are 0.09 and 0.02. To illustrate the use of these combined elasticities, if the price of non-physician inputs rose by 30 percent relative to the general price level, the elasticity from the first and second regressions imply that gross physician income would rise by slightly less than three or slightly less than one percent, depending on which set of coefficients is used. In recent years, the growth in relative factor prices physicians pay has been far less than 30 percent. Thus, their contribution to growth in real gross incomes of doctors has been negligible.

EMPIRICAL RESULTS: NET PHYSICIAN INCOME

Table 4-3 contains four regressions with net physician income dependent variables. The third and fourth regressions have physician net income (NTY) as the dependent variable; the income variable in the fifth regression, total net income (TNTY), includes contributions to pension plans and other deferred income during the current year. In the sixth, the dependent variable is net physician income (exclusive of deferred income) per hour spent in patient care (NTYH). Because of a substantial number of missing values on deferred income, the total net income regression is based on a substantially smaller sample than the others. As noted above, responses to the deferred income question were obtained from a disproportionate number of physicians with high earnings. The distinguishing characteristic of the fifth regression is the inclusion of the predicted percentage of the doctor's patients with Medicaid rather than the actual values. Because several explanatory variables in Table 4-3 are also predictors of the Medicaid proportion, some of the parameter estimates are very sensitive to choice of the Medicaid variable, a pattern also observed in the fee regressions presented in the previous chapter. The discussion of findings conentrates on regressions three, four, and six pertaining to physicians' net incomes.

On the whole, the estimated effects of "specialty" and "other physician and practice characteristics" on fees closely resemble those in the gross income regressions. The highest earners tend to be in the surgical specialties. With the exception of pediatrics, general-family medicine is at the bottom of the earnings scale. Pediatricians fare worse in net income than in gross income. Board certification raises net income slightly whereas no effect was evident for gross income. There is evidence that foreign medical school graduates earn less, holding other factors constant, as reported above for gross income.

The net income (NTY) regressions show an inverted U-shaped experience-earnings profile, but it is nevertheless a shallow one. One could characterize it as inverted J-shaped, that is, a small increase in earnings from the lowest experience category of six percent to the mid-years with about a 16 percent earnings reduction after 35 years as a physician. Judging from the net income per hour (NTYH) regression, earnings per hour vary less by experience. The parameter estimates imply that about a third of the reduction in earnings after 35 years of experience is attributable to reduction in patient-care workhours.

Substantial fee and gross income differentials on the basis of corporate status have been reported above. Differences are even greater for net than for gross income. Since incorporation offers advantages in terms of deferring income, it was expected that coefficients on variables identifying incorporated physicians would have been comparatively large in the total net income regression; in fact, the coefficients are only very slightly higher. The net income per hour coefficients for corporate status-group size are lower than in the other net income regressions implying that shorter number of workhours is one reason physicians in unincorporated solo practices earn less.

As anticipated, female physicians, employed physicians, and those practicing in prepaid group practices earn less. Lower earnings on the part of female physicians does not directly contradict the gross income result for this variable because the samples on which the regressions are based differ. The first gross income regression is based entirely on solo practitioners, whereas the net income regressions contain observations on partnership and group practices as well as on solo practice.

Being affiliated with a prestigious or input-intensive hospital is not a source of high earnings. Although average cost per adjusted patient day in the physician's primary hospital has a uniformly positive impact on earnings, the associated elasticities, evaluated at the mean of the average hospital per diem cost, are low, never higher than 0.13. As with gross incomes, results on the no primary hospital affiliation variable are puzzling. Although earnings are lower for physicians without a primary hospital, earnings per hour are 21 percent higher on average.

The estimated effects of county per capita income on earnings is about the same as for gross income. The effect of per capita income on physician's hourly earnings is almost as high as on annual earnings, suggesting that most of per capita income's effect is on the hourly wage rather than on workhours.

Physician-population ratio elasticities obtained for net income are about the same as those for gross income. Estimates based on regressions with alternative ratios are presented in Table 4-3.

Percentages of patients with private insurance and Medicare have uniformly positive effects on net income. Associated elasticities for these two variables range from 0.06 to 0.09 for private insurance and 0.02 to 0.04 for Medicare. The net hourly earnings elasticities are only slightly lower than those for annual income. The elasticity associated with the predicted Medicaid variable is -0.34; a similarly high elasticity was obtained in the fee analysis when a predicted Medicaid variable was employed. With the actual Medicaid percentage, there is no descernible Medicaid effect.

Combining elasticities from individual factor price variables, using the same weights as previously, results in total factor price elasticies of 0.02, -0.01, 0.13, and 0.06 for the third through sixth regressions, respectively. Physicians' earnings appear to be insensitive to changes in the prices of non-physician inputs (relative to the cost-of-living).

EMPIRICAL RESULTS: TOTAL VISITS

Although total visits (TVIS) information is available from the HCFA-NORC surveys, the total may be highly misleading since visits are extremely heterogeneous. A surgical operation, for example, involves much more physician and staff effort than an office visit. To reduce the degree of heterogeneity somewhat, the total visits measure used in the regression is the sum of visits of various types weighted by the mean length-of-visit by type of visit.[2]

The empirical results on total visits merit attention for two reasons. First, reasons for variations in workload merit interest in their own rights. Second, dividing gross revenue by a measure of output yields a measure of the overall fee level of the physician. In this way, inferences about the strength of various fee determinants can be obtained from estimated parameters in Table 4-3. Of course, although this provides a useful check on Chapter 3's results, it is not a perfect one since total visits are hardly a perfect measure of physician output. To the extent that the output measure does not adequately measure case complexity, inferences about fee-setting determinants may also be erroneous. The most interesting results pertain to corporate status, prepaid group practice, hospital characteristics, area product demand variables, and factor prices.

Thus far, Table 4-3's results have revealed that incorporated physicians earn substantially more than their unincorporated colleagues. This is true when income is calculated on an hourly as well as an annual basis. The total visits results suggest they also see more patients. In fact, partitioning gross revenue into gross revenue per visit and total visits, it appears that most of the incorporated-unincorporated differential reflects volume rather than price variation. Given the net income per hour results, there is also an implication that incorporated physicians see more patients per hour, a result consistent with the length of office and hospital visit results presented in Chapter 3. On average, output per physician in practices relying solely on income from prepaid plans is about 15 percent lower than in other practices, but some caution is warranted since the coefficient, though larger than its standard error, is not statistically significant at conventional levels. Viewed in conjunction with the corresponding gross income coefficient in the second regression, there is no apparent difference in terms of gross income per unit of output between prepaid and other types (predominantly fee-for-service) of practice.

Neither evidence presented in Chapter 3 nor in this chapter thus far has implied that physicians associated with teaching hospitals reap any financial advantage from their affiliation. The total visit regression implies that such physicians have eight percent lower workloads on average. On a gross revenue per unit of output basis, they are slightly higher. The magnitude of difference is consistent with the fee results presented in the last chapter. The coefficient for average cost per adjusted patient day suggests that workloads are substantially lower for physicians in costly (or output intensive) hospitals. Given the finding of no impact on gross income, these results imply that physicians in input-intensive hospitals charge higher fees.

The per capita income coefficient is positive in the visits regression but it is not statistically significant at conventional levels and the implied elasticity is small, only 0.08. Subtracting 0.08 from 0.45, the per capita income elasticity in the second gross income regression, one obtains an implied elasticity on fee levels of 0.37. This is somewhat higher than the corresponding elasticities obtained in Chapter 3 which ranged from 0.03 to 0.25 with a central tendency between 0.08 and 0.15.

Although the physician-population ratio coefficient is statistically significant at the one percent level, the elasticity of -0.09 suggests that physician avaialability has only a small effect on physician workloads. The implied availability elasticity on fees is zero; in Chapter 3 corresponding elasticities were reported in the -0.0 to -0.1 range. Elasticities based on the alternative ratios, as seen in Table 4-3, are -0.10 and -0.11.

All three insurance variable coefficients are significant at the five percent level or higher. The results for insurance, however, provide the only evidence contradictory to Chapter 3. More specifically, if Table 4-3 results on insurance are to be believed, insurance has no impact on physician fee levels since two out of three insurance coefficients in the visits regression exceed their counterparts in both gross income regressions. The analysis of insurance effects on fees was more detailed in the last chapter than here and on balance merits somewhat more confidence, but the failure to obtain corroborative evidence from Table 4-3 is bothersome.

Using the weighting scheme described above, the combined non-physician input price elasticity on visits is -0.074. Subtracting this from the elasticity of 0.019 from the second regression, one obtains an elasticity of factor prices on fees of 0.093. In the last chapter, combined factor prices elasticities fell in the 0.1 to 0.2 range.

Unlike insurance, this latter result is very close.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Detailed information on physicians' incomes and workloads and their determinants, available for the most part from the HCFA-NORC surveys, has permitted an in-depth empirical investigation into sources of variation in incomes and workloads. These are the principal findings: First, estimates of net physician income are reasonably close to those obtained from other sources, in particular the American Medical Association and Medical Economics. Weighting by the weights provided in the HCFA-NORC survey file makes little difference to estimated mean values of physicians' incomes; the unweighted means tend to be a little higher.

Second, as in the analysis of fees, there are substantial differences in gross and net income according to corporate status. These differences are evident from both two-way tables and from regressions containing a rather lengthy list of explanatory variables. Part of the difference in income reflects workhour and workload differences between physicians in incorporated versus unincorporated practices. But as in the fee analysis, there are significant differences related to corporate status in compensation per unit of input or output. Precisely why these latter differences occur is not clear. Although the possiblity cannot be ruled out at this point, there is no reason to believe that the very process of incorporation causes higher gross and net incomes as well as higher fees.

Third, as in Chapter 3, estimated impacts of physician availability on the dependent variables are low, although in the direction predicted by "standard" microeconomic theory. Downward bias due to unaccounted for border-crossing is a real possiblity. Implied physician-population ratio elasticities on gross income per visit, a measure of a physician's fee, are around zero, even lower (in absolute value) than those reported in the previous chapter.

Fourth, private insurance and Medicare have significant impacts on gross and net incomes of physicians. The estimated effect of these variables on total visits is about the same as on gross income. This implies no insurance effect on the average fee level, this chapter's only substantial contradiction with the previous one. Since the fee analysis used direct fee measures, on balance, those results deserve greater weight with regard to fees.

Fifth, such factors as physician specialty are important in explaining variations in physicians' incomes. However, as in Chapter 3, some other measures, such as board certification status and characteristics of the physicians' primary hospital, demonstrate very little explanatory power. Studies emphasizing the importance of the latter set of variables may be barking up the wrong tree.

FOOTNOTES TO CHAPTER 4

[1] See Chapter 2 and Appendix A for further comparisons of AMA, HCFA-NORC, and Medical Economics data.

[2] The weights are: office visits = 1.0; house calls = 2.6; hospital inpatient visits = 0.97; hospital emergency room and out-patient clinic visits = 1.43; operations and assists = 5.17; and nursing home, convalescent home, and extended care facility visits = 1.43.

SECTION III

The Malpractice Insurance "Crisis"

Chapter 5

Physician Demand for Malpractice Insurance

Frank A. Sloan

INTRODUCTION

Much has been said and written about physician responses to the rise in malpractice premiums and the threat of medical malpractice litigation. Faced with an increased threat of malpractice suits, physicians may increase their purchases of malpractice insurance, provide extra care per patient, avoid providing care in certain settings in which the likelihood of being sued is high, alter the composition of services (e.g., provide less or no surgery), raise fees to cover extra costs of provision of services, and/or, in the long run, relocate in an area in which both the threat of malpractice litigation and premiums are lower.

This chapter focuses on the first type of response, the physician's decision to purchase medical malpractice insurance. The next sections discuss conceptual considerations, data, and empirical findings. Conclusions and implications are discussed in the final section.

CONCEPTUAL CONSIDERATIONS

Faced with the possibility of a lawsuit, the physician has two broad alternatives: the purchase of insurance in the marketplace and self-protection. Many of the self-protective acts have already been mentioned. The option of self-protection adds a great deal of realism to the conceptualization of physician responses in the face of uncertainty. At the same time, however, it greatly complicates the theory.

Four general factors determine the demand for malpractice insurance: its price, the risk of being sued and the amount of loss if the court decides in the patient's favor, physician attitude toward risk, and the cost of self-protection.

The premium facing the physician approximately consists of an amount the physician expects to receive in the form of benefit payments in the event of successful litigation and a loading factor. If it were possible to levy an individual charge on each physician precisely in accordance with the insurer's payout to policyholders (that is, if the loading were zero in every instance), insurance would be provided for a zero price. However, the loading is not zero, first because of insurer administrative cost and profit, but also because the expected benefit payout is very difficult to ascertain on a per physician basis. Not only does the risk of being sued depend on a number of intangibles, such as physician personality, and more tangible factors, such as volume and sites of service, but also a suit may be filed a number of years after care is rendered. Risk discrimination is indeed a difficult task for an insurer. Justified or not, sellers of malpractice insurance only make very limited attempts at it. Furthermore, given the lengthy time lag between provision of care and litigation, setting of premium rates appears to be only weakly related to the actual historical experience of malpractice litigation in the area. For example, correlations between malpractice premiums by state and several measures of malpractice litigation activity in 1970--claims filed, cases won by plaintiffs, and mean size of awards--are quite low, 0.3 or less. Premiums may be set with a view toward future payouts, but projections must be determined on some other basis than historical experience.

In the absence of experience rating of premiums and with the method of premium-setting probably unclear to individual physicians as it is to researchers, there is likely to be a substantial discrepancy between the amount the physician pays in premiums and the expected payment he may expect to receive in the event that malpractice litigation against him is successful.

For purposes of premium setting, insurers differenatiate between physicans on the basis of specialty and, for general-family practitioners, on whether or not they perform surgery. Premiums only rarely reflect the physician's own litigation experience; no distinction is made according to whether the physician has a substantial hospital patient load, the number of patients seen per week, the number of testing and other precautions taken, or the number of surgical operations per week. Yet it is known that certain activities, such as hospital work in general and surgery in particular, are more likely to lead to litigation than is office care. Thus, the physician with a large hospital-oriented practice faces a higher risk than his colleague in the same specialty with a small practice and/or office-based care orientation. Given this lack of differentiation in premium-setting, the low risk physician effectively faces a higher price of malpractice insurance than his higher risk colleague. As the effective price rises, one expects less insurance with lower liability limits to be demanded.

Clearly, in view of the methods used to establish premiums, risk as perceived by the physician is intimately related to the effective price. But, holding price constant, there still should be differences in the amount of malpractice insurance demanded because of differences in risk. For example, a neurosurgeon would demand more coverage than a pediatrician even if the risk-adjusted premium is the same because the former faces both a higher likelihood of being sued and incurs a larger loss on average if the patient's case proves successful.

Much of the theory underlying any insurance purchase decision relates to the risk preferences of the potential purchaser. A risk-neutral individual is indifferent between an actuarially fair insurance policy and no insurance. By contrast, a risk averter, probably a more accurate description of most individuals, is willing to pay a greater sum than an actuarially fair premium to indemnify him or herself against the possiblity of a particular loss. A risk lover would not even accept an actuarially fair premium.

In Chapter 15 Schlesinger assesses the potential effects of risk aversion on the physician's decision to purchase malpractice insurance and to engage in actions that lower the physician's probability of being sued. He finds that an increase in the physician's degree of risk aversion, *ceteris paribus*, implies an increase in the optimal liability limit. Second, the effect of increased risk aversion on the level of care optimally provided (from the physician's standpoint) cannot be determined on the basis of theoretical analysis. However, for reasons explained by Schlesinger, if the chances of a malpractice loss are very slight, an increase in the degree of risk aversion will result in more care being used by the physician.

If the physician gains protection by adjusting both insurance and care levels, most predictions are off. As Ehrlich and Becker (1972) have demonstrated, insurance and self-protection can be either complements or substitutes. However, Schlesinger shows that if the physician purchases full insurance coverage and hence is completely insulated from any further losses, there is no purpose in using care as a self-protection device. Of course, as a practical matter, full insurance is not possible since the physician cannot indemnify himself against loss of reputation, anxiety, and time lost from medical practice due to litigation, irrespective of its outcome.

Empirical measurement of risk aversion is fraught with difficulty. Typically, risk aversion is hypothesized to vary with a person's income or wealth. However, measured income may be considered endogenous. The empirical analysis of malpractice demand presented below contains one income measure that is less subject to the endogeneity problem, namely a dummy variable which equals one if the physician's family obtains more than $10,000 per year from nonmedical sources. Other measures, albeit crude, are physician marital status and the number of child dependents. The fact that the theory generates no definite predictions with regard to increasing degrees of risk aversion is especially serious when compounded with these imperfect empirical measures.

As discussed more fully by Ehrlich and Becker (1972), the marginal cost of self-protection depends on both the marginal productivity of self-protection and the prices of inputs used in self-protective activities. If, for example, physicians find that having performed a certain test does not protect them in the courts, it is less likely that a "defensive medicine" strategy will include this particular test. Furthermore, if prices of factors used in the production of the test are relatively high, the test is less likely to be utilized. It is likely that certain practices may be quite effective in deterring successful malpractice litigation. Unfortunately, such practices are difficult to assess in quantitative terms.

DATA AND ESTIMATION

The HCFA-NORC surveys contain a limited amount of information on the physician's malpractice insurance purchases. The 1977 survey requested information from physician respondents on liability limits of the physician's malpractice insurance policy in 1976 and 1975 as well as the amount of the premium paid in both years. The 1978 survey requested only data on premiums paid in 1977 and 1976 and whether coverage was the same or different in 1977 versus 1976. The 1978 questions were simplified because respondents to the 1977 survey experienced difficulties in answering the liability limit questions in that year.

At an early stage of the analysis, responses to questions on liability limits were correlated with the ratio of actual premiums paid by the physician divided by the average premium paid by physicians in the state for a $100,000/ $300,000 policy. This is an indirect but probably reasonably accurate measure of the quantity of malpractice insurance purchased. Also, demand for malpractice insurance regressions were estimated with the liability limits and, alternatively, the ratio of the actual premium to a premium for a $100,000/$300,000 policy ratio as dependent variables. The regressions with liability limit dependent variables were difficult to interpret, whereas many aspects of the regressions with the ratio dependent variable had a plausible interpretation. Moreover, simple correlations between the liability limits and the ratio proved to be extremely low (around 0.02).

Further analysis of the liability limit variables was discontinued because of (1) the poor performance of these variables in preliminary regressions, (2) NORC's bad experience in obtaining liability limit data, and (3) the lack of information on certain proxies for physician risk aversion, available from the 1978 survey but not the 1977 survey. This chapter's empirical analysis, unlike the preceeding two, is based entirely on responses of solo practitioners to the 1978 survey.

Although the ratio variable is superior to the liability limit variables, not conceptually but rather in terms of the data available for analysis, it too has weaknesses. First, there is no reason to believe that when the ratio is two, for example, the physician has twice as much insurance as when the ratio is one. It is more appropriate to use the ratio for purposes of constructing an ordinal rather than a cardinal measure of coverage. Second, if the ratio appears as the dependent variable and the premium for $100,000/$300,000 coverage is an explanatory variable, there is the possibility that the parameter estimate on the premium variable will be biased in the negative direction because of error-in-measurement common to both the explanatory and dependent variable

To circumvent these problems, the following approach has been adopted. The ratio of the physician's actual 1977 premium to the average $100,000/$300,000 premium charged physicians in 1977 in the respondent's specialty and state has been used to classify physicians in one of three mutually-exclusive categories: ratios of 0.7 or less = "low coverage" (Group 1); 0.7 to 1.8 = "medium coverage" (Group 2); and over 1.8 = "substantial coverage" (Group 3). Since the actual premium is given for the practice as a whole, ratios cannot be calculated for multispecialty groups. Although single specialty groups can be identified, for reasons of consistency it seems advisable to exclude group physicians altogether. Of the 2,538 solo physician respondents to the 1978 survey included in the malpractice insurance demand regressions, 18.8, 51.4, and 29.9 percent fall into Groups 1 through 3, respectively.

Multinomial logit analysis is a form of multivariate analysis that is appropriately employed when the dependent variable identifies alternative groups or choices. The following brief explanation is necessary for understanding the empirical results table in the next section.

Suppose there are n choices and x_i is a vector of individual characteristics and/or community characteristics pertaining to the individual, as defined in the preceding section, then the probability that the ith alternative is selected by the person with individual and/or community characteristics x_i is

$$P_i = e^{a'_i x} \Big/ \sum_{i=1}^{n} e^{a'_i x}. \qquad (5\text{-}1)$$

Given a like expression for P_j, taking logs, and dividing P_i by P_j

$$ln(P_i/P_j) = (\alpha_{i0} - \alpha_{j0}) + (\alpha_{i1} - \alpha_{j1})x_1 + (\alpha_{i2} - \alpha_{j2})x_2 \qquad (5\text{-}2)$$

With multiple logit analysis one estimates $n - 1$ functions, such as Equation (5-2), from which all of the underlying parameters may be derived. The choice of denominator probability is fully arbitrary and irrelevant for purposes of estimation. For example, $ln(P_k/P_j)$ may be derived once functions for $ln(P_k/P_i)$ and $ln(P_j/P_i)$ have been estimated, since $ln(P_k/P_j) = ln(P_k/P_i) - ln(P_j/P_i)$. A chi-square test with $n - 1$ degrees of freedom is used to test the null hypothesis that a specific explanatory variable makes no contribution to the choice among the alternatives.

In this application n equals 3. The denominator probably is P_3, the probability that the physician belongs in the substantial malpractice insurance coverage cateogry. The parameter estimates themselves are not directly interpretable. For this reason, a table of predicted probabilities conditional on assumed values of exogenous variables is presented in the next section.

REGRESSION RESULTS

Table 5-1 presents the results of the logit analysis of physician demand for malpractice insurance. Over half of the variables show statistically significant differences among the three groups; many of these, however, are specialty dummies.

Probably the key explanatory variable of interest is the malpractice premium. The logit regression implies that as premiums rise, physicians reduce the amount of malpractice insurance pruchased. The high level of statistical significance provides one reason for confidence in this finding. The predicted probabilites presented in Table 5-2 provide another. Predicted probabilities, evaluated at the observational means of the independent variables, slighlty underpredict the likelihood of belonging to Groups 1 and 3 and correspondingly overpredict the probability of belonging to Group 2. At one standard deviation above the sample mean premium for \$100,000/\$300,000 coverage, \$5,786, the probability of belonging to Group 1 more than doubles and the probability of belonging to Group 3 falls by a factor of 4.5. At a premium of \$1,000, almost \$2,000 below the mean, virtually all physicians (94 percent) are predicted to belong to either Groups 2 or 3. These are substantial responses to changes in the premium by any standard. Presumably, if the explanatory premium variable had been deflated by the actuarially fair premium (for the physician respondent), the estimated degree of responsiveness of demand to premiums would have been even higher.

Table 5-1: Physician Demand for Malpractice Insurance

Explanatory Variable	$ln(P_1/P_3)$	$ln(P_2/P_3)$
Specialty		
Allergy	-0.78	-0.050[c]
Cardiovascular disease	-1.88	-0.22[c]
Dermatology	-1.24	0.28[a]
Gastroenterology	-1.95	-0.81[a]
General surgery	-2.70	-0.80[a]
Internal medicine	-0.41	0.20[b]
Neurological surgery	-12.88	-3.72[a]
Obstetrics-gynecolocy	-3.17	-0.93[a]
Ophthalmology	-0.77	-0.37[c]
Orthopedic surgery	-3.98	-1.65[a]
Otolaryngology	-2.04	-0.78[a]
Pediatrics and pediatric surgery	-1.21	-0.079[a]
Urology	-2.41	-0.48[a]
Other Physician and Practice Characteristics		
Board certified	-0.023	-0.009
Distinguished U.S. med. school	-0.10-	-0.024
Undistinguished U.S. med. school	-0.064	-0.024
Distinguished foreign med. school	1.15	0.70[b]
"Third World" foreign med. school	-0.10	-0.052
Other foreign med. school	0.051	0.255
Less than 10 years experience	-0.27	-0.19
More than 35 years experience	0.38	0.19
Incorporated, solo	-0.53	-0.30[a]
Female MD	0.20	0.10
Married MD	-0.14	0.020
Number of children of MD, 18 yrs. or less	0.056	0.001
Income from non-med. sources over $10K	-0.018	0.083
Characteristics of MD Hospital		
Affiliated with med. school hospital	0.18	0.12
Affiliated with limited teaching hospital	-0.63	-0.29
No primary hospital affiliation	1.52	0.15[a]

Table 5-1: Physician Demand for Malpractice Insurance (continued)

Explanatory Variable	$ln(P_1/P_3)$	$ln(P_2/P_3)$
Area Product Demand		
Physicians per 10,000 population	0.018	0.013[a]
Per capita income	-0.0003	-0.0003[a]
Percent private insurance	-0.012	-0.006
Percent Medicare	-0.027	-0.012[a]
Percent Medicaid (actual)	-0.004	-0.008
Factor Prices		
Hospital wage (weekly)	0.0006	0.0021
Rent (annual)	0.0006	0.0004[a]
Malpractice premium (annual)	0.0008	0.0005[a]
Constant	0.024	0.66

Notes:

a = Statistically significant at one percent level (chi-square).
b = Statistically significant at five percent level (chi-square).
c = Statistically significant at ten percent level (chi-square).

Indications of statistical significance refer to pairs of parameter estimates associated with the independent variables.

Table 5-2: Predicted Probabilities: Demand for Malpractice Insurance

	P_1	P_2	P_3
Observational means	0.15	0.58	0.27
Malpractice premium			
$1,000	0.06	0.41	0.46
$5,786	0.37	0.58	0.06
Incorporated			
yes	0.12	0.56	0.32
no	0.16	0.59	0.25
Primary hospital affiliation			
yes	0.37	0.44	0.18
no	0.13	0.60	0.28
Physician-population ratio			
4.35/10,000	0.13	0.55	0.32
36.79/10,000	0.17	0.60	0.23
Per capita income			
$4,246	0.16	0.63	0.21
$7,530	0.13	0.53	0.34

There is a possible objection to the conclusion that demand is highly responsive to premiums. If the premium data for \$100,000/\$300,000 policies were subject to substantial errors-in-variables, large errors could cause physician respondents to be misclassified. For example, if the premium is greatly overstated, the respondent may be classified in Group 1 when he should have been placed in Group 2. These errors alone could produce the negative relationship between demand and the \$100,000/\$300,000 premiums. Certainly grouping reduces this bias, but possibly it does not eliminate it entirely. Given the broad intervals used to classify physicians, it is not likely that more than a handful of physicians have been erroneously classified.

The weighted visits regression presented in the previous chapter showed that the following types of physicians, aside from specialty differences, have comparatively high workloads: incorporated physicians and those located in areas with low physician-population ratios, high per capita incomes, and high proportions of insured patients. Relatively low workloads were found for "third-world" FMGs, female physicians, physicians affiliated with teaching and costly hospitals, and those practicing in comparatively high factor price locations.

Judging from Table 5-1, there is a remarkably close positive association between factors associated with the variations in workloads and the amount of malpractice insurance coverage purchased. As seen in both Tables 5-1 and 5-2, incorporated physicians are more likely to belong in the substantial coverage category than their unincorporated colleagues. Rather than interpret the corporate status coefficients in terms of workloads, one might emphasize the fact that incorporation insulates the physician's personal wealth from malpractice litigation. But if this were an important factor in the doctor's decision, incorporated physicians would purchase less rather than more malpractice insurance.

Also consistent with the workload explanation are logit coefficients for female MDs (although not statistically significant at conventional levels) and the area product demand coefficients. As seen in Table 5-2, physicians located in physician dense areas are less likely to have substantial coverage. The same result holds for low personal per capita income. An alternative explanation for the per capita income result is that affluent patients are more likely to sue the physician, and malpractice insurers do not take this factor into account in setting premiums. It is not possible to distinguish the latter from the workload interpretation, but in view of other Table 5-1 results, differential workloads seem to be at least one element underlying the results for per capita income. The factor price coefficients are also consistent with the workload interpretation, in particular those for office rent.

The nature of the physician's hospital affiliation only appears to affect demand for malpractice insurance when there is no hospital affiliation. As seen in Table 5-2, physicians without a primary hospital affiliation are almost three times as likely to be in Group 1 than their affiliated colleagues, holding a large number of other demand determinants constant. As noted above, suits are much more likely to stem from hospital care than from office care. Specialty coefficients are statistically significant in the vast majority of instances. Taken as a group, they imply that specialists are more well-insured than general-family practitioners. The specialty dummies embody a number of influences, including variations in the "need" for coverage.

The literature on insurance emphasizes the role of variations in the degree of risk aversion, as indeed it should. However, it is quite difficult to operationalize the concept of risk aversion empirically. Three proxies for physician risk aversion are included in the logit regression: a variable which equals one if the physician is married and is zero otherwise; the number of children of the physician aged 18 or less; and a variable which equals one if the physician's household received income from any non-medical source amounting to more than $10,000 and is zero if the physician either answered "no" or did not answer. None of these variables shows any relationship to malpractice insurance demand. Clearly, more direct measures of risk aversion are needed.

CONCLUSIONS AND IMPLICATIONS

Theoretical analysis of physician behavior under the uncertainty of malpractice litigation yields few definite predictions which might serve as the basis for empirical testing. Especially when signs of coefficients can go either way, and when there are legitimate questions about the way a number of key variables have been measured, the empirical researcher must exercise caution.

Subject to this caveat, the results imply that, as a general matter, physicians are quite rational purchasers of malpractice insurance. When the price falls, a greater amount is purchased. To the extent that insurers do not risk discriminate, the door is open for large purchases on the part of physicians who face unusually high risks. Other physicians in turn subsidize these physicians although their insurance purchases are comparatively low. The effect of the malpractice premium on the care level and on "defensive medicine" is explored in the next chapter.

Chapter 6

State Responses to the Malpractice Insurance "Crisis"

Frank A. Sloan

INTRODUCTION

The medical malpractice "crisis" of the mid-1970s involved both a dramatic increase in premiums and a reluctance on the part of many companies to write medical malpractice insurance policies. Increased premiums and nonavailability of coverage in turn were perceived by the public and their elected representatives as potential sources of medical care cost inflation and possibly nonavailability of certain types of needed medical services. Virtually all states took some type of legislative action to ensure availability of malpractice insurance at a reasonable price. During the late 1970s, many of these new laws were tested in state courts.[1] Although the rate of premium inflation and availability problems had abated by the late 1970s, there were several predictions that these improvements were only temporary.[2]

To date, no one has isolated the effects of specific legislative actions on either the price or availability of malpractice insurance. It is now possible to gauge some short-term effects. Statutory changes potentially affect the frequency of claims, judicial determination in favor of either plaintiff or defendent, and the size distribution of settlements. Expected payouts of insurers, as well as projected administrative costs and profit margins, in turn, are reflected in premiums.[3] It is quite possible that legislative initiatives may have unintentionally fooled insurers by creating anticipations that settlements would fall when in fact this did not occur. Likewise, the publicity effect surrounding legislative activity may have caused the public and, for that matter, juries to become more cost conscious when in fact the direct constraining impact of the laws themselves was rather minimal. For policy purposes, these distinctions may be unimportant, even though, admittedly, there is less chance that the more purely psychological reactions would repeat themselves in some future crisis.

The next two sections provide some background information on the malpractice insurance crisis of the mid-1970s and describe specific legislative responses to the crisis at the state level. Empirical specification of premium regressions and discussion of empirical results are provided in the following sections. The final section presents conclusions and implications for public policy.

BACKGROUND

There is substantial variation in malpractice insurance premiums--among physician specialties, across states, and over time. In the mid-1970s, premiums in a high risk specialty, orthopedic surgery, were about six times greater than those in lowest risk ("Class 1") specialties.[4] As an illustration of interstate variation in premiums within a specialty, premiums paid by orthopedic surgeons in 1974 varied from a high of $8,352 (New York) to a low of $479 (North Carolina), more than a 17-fold difference.[5] As discussed more fully below, both premium levels and annual percentage changes in premiums among specialties within a state are very highly correlated. Thus, this degree of interspecialty and interstate dispersion has been preserved since 1974. Over 1974-77, malpractice premiums almost doubled, following a three to four year period of relative calm; the 1977-78 change (the latest year available) was negligible.[6]

The reason for interspecialty variation in premiums is reasonably well-understood. Claims against physicians in surgical subspecialties in particular are much more frequent than in fields without a hospital orientation, such as general/family medicine and pediatrics.[7] Sources of interstate and intertemporal variation are much more complex.

group, these factors may explain a secular growth in litigation and premiums better than the "crisis" in insurance availability and price.

There is no consensus as to why the crisis of the mid-1970s occurred, or, for that matter, why it passed. The industry justified substantial premium increases on grounds that they were losing money at their then-current malpractice insurance rates. However, profitability not only depends on loss ratios, but also on returns on investment of insurer reserves.[10] Clearly, insurers suffered at least paper losses in the stock market during 1974-75, and this development may have been contributory. Critics of the insurance industry, such as Law and Polan (1978), have stated that with a few exceptions, such as New York and California, insurance companies in the mid-1970s were making decisions on the basis of events having little to do with their local situations. Law and Polan argued that the broad-scale panic was due at least in part to the actions of a single company, Argonaut, which had responded decisively to its adverse loss experience in several markets.[11] Rather than assessing their own situation, other companies simply panicked. According to this psychological view of the crisis, matters eventually settled after time allowed more objective assessments of the situation. Others have attributed the end of the crisis to fear of countersuits and lack of lawyer familiarity with the new state malpractice statutes if not the effects of the statutes themselves.[12]

STATE LEGISLATIVE RESPONSES

The crisis of the mid-1970s provided the impetus for numerous legislative proposals applying to causes of action alleging medical malpractice. Legislators assumed that if the legislative proposals could reduce the number and dollar amounts of malpractice awards, insurers would be in a better position to predict recoveries and therefore maintain coverage at reasonable rates and assure availability of malpractice insurance. Statutory changes were quite narrowly focused on medical malpractice. Many of these new laws were being tested in the courts as the decade of the 1970s ended.[13] This section briefly describes most of the major legislative changes, the effects of which are evaluated in terms of premiums below.[14] Legislative proposals are classified into (1) tort modification, (2) alternatives to trial, and (3) insurance provisions.

Tort Modification

1. Limitations on Provider Liability, Recovery by Plaintiff, and Patient Compensation Funds: Several states enacted laws placing a dollar maximum on the amount providers are required to pay in medical malpractice cases. A limitation on provider liability was often imposed in conjunction with a limitation on plaintiff recovery of a patients' compensation fund. A ceiling on either the provider's liability or plaintiff's recovery potentially shifts some costs of damages to plaintiffs. Conversely, to the extent that awards had been excessive heretofore, particularly for such subjective items as "pain and suffering," savings accrue to physicians and the public at large. Although these laws potentially reduce premiums, they will be successful only to the degree that settlements would have otherwise exceeded the ceilings and/or potential plaintiffs and especially their attorneys are discouraged by the curtailment of extremely high settlements. Unfortunately, data are not available for comparing the frequency distribution of settlements to the ceilings in states where these limitations were enacted.

Patient compensation funds have been established to pay plaintiffs for damages incurred above the statutorially determined amount for which the provider is liable. These funds are typically supported by an annual surcharge assessed against the provider, with the surcharge being some stated percentage of the premium but set so as to reduce the relative burden on providers in high risk specialties. The main effect of such funds, if any, is likely to be on amounts of insurance (liability limits) purchased by providers rather than on the premium for a standard amount of coverage (such as a $100,000/$300,000 policy).

2. *Res Ipsa Loquitur*: The doctrine of *res ipsa loquitur* applies when a plaintiff can show (1) the event only occurs when someone is negligent, (2) harm was caused while the instrumentality causing the injury was exclusively controlled by the defendant, and (3) the plaintiff did not contribute to the injury.[15] In years immediately prior to 1975, courts in a number of states expanded applicability of the doctrine of *res ipsa*; they had increased the effect of its applicability from an inference of guilt to a presumption, which, if not rebutted, would require a jury to reach a finding of guilty.[16] Since 1975, state legislation has delineated situations in which *res ipsa* can be applied (e.g., to foreign objects left in the body, radiation burns); in some states (e.g., Washington), the use of *res ipsa* in malpractice cases was virtually eliminated. Evidence from a recent study of medical malpractice claims indicates that *res ipsa* cases are moderately more successful in terms of percentages of cases won and are settled more rapidly, but the differences are not substantial.[17] Hence, limiting use of *res ipsa* may have some but probably not a dramatic effect on premiums.

3. Statute of Limitations: Statutes of limitations have received considerable attention in discussions of medical malpractice insurance.

One reason is the lengthy lag time which often occurs between the date an injury occurs and the date the claim is first made. This problem is particularly severe in this area since malpractice insurance has typically been sold on an "occurrence" basis. That is, the insurer protects the provider against any claim that may arise from a litigatable "event" during the policy years. Insurers have maintained that the persistent threat of a suit compels them to maintain substantial reserves, and, in any case, rate-setting is made more difficult.[18] Furthermore, there is empirical evidence that claims filed five years after the injury are more than twice as expensive as the average award.[19] State legislatures modified existing statutes of limitations to establish definite, presumably shorter, periods during which a medical malpractice action must be brought. However, the new limits contain exceptions, which, in addition to interpretations of state courts, could have important implications for the effectiveness of the new limits.[20]

4. Informed Consent: The doctrine of informed consent requires that a provider disclose information pertinent to the nature, purpose, and risks associated with a proposed medical treatment. Unfortunately, while the doctrine's intent is clear, in practice whether patients were in fact properly informed has been determined on a case-by-case basis. During the mid-1970s, many experts held that ambiguity created by this doctrine was in itself a source of litigation, and several states codified the doctrine of informed consent to insure uniform definition and application.

5. Contingent Fee Regulation: It is often argued by physicians and others that payment of lawyers on a contingent fee basis for work on malpractice cases increases the total number of claims.[21] Assuming patients are risk averse, a plausible assumption for plaintiffs in

the aggregate, economic theory supports this assertion.[22] Unfortunately, there is no empirical evidence on this point. Since 1975, several legislatures have limited attorneys' fees in medical malpractice cases either by (1) empowering state courts to determine reasonableness of attorneys' fees, (2) fixing a percentage ceiling for contingent fees by statute, or (3) adopting a sliding scale which bases the contingency fee percentage on the amount of recovery. The latter two approaches, at least, have the potential of reducing lawyers' incentives to accept malpractice cases; the first is weakened by courts' reluctance to interfere with the attorney-client relationship.[23]

6. Collateral Source Provisions: The collateral source rule proscribes the application of benefits received by an injured party from sources other than the defendant as an offset to compensation due from the defendant. Hence a medical malpractice plaintiff may collect benefits substantially in excess of damages incurred. A number of states enacted legislation during the mid-1970s to limit such duplication of payments. Two types of laws have been enacted. One type permits introduction of evidence of payments received from collateral sources, allowing the jury to consider such evidence in determining the defendant's obligation to the patient-plaintiff; the other approach requires that there be an offset.[24] These changes have been controversial. Proponents of the collateral source rule have argued that the rule preserves patients' incentive to purchase insurance and the reduction in defendants' liability may reduce the deterrent effect of liability.[25]

7. *Ad Damnum* Clause: The *ad damnum* clause is part of the plaintiff's initial pleadings, stating amount of monetary damage incurred and the settlement requested. Although *ad damnum* may be seen as no more than an

initial asking price, it may influence the jury to award a larger settlement. More recent legislation eliminates *ad damnum*, but some laws now also require that the defendant be informed of the precise amount of recovery sought by the plaintiff during pre-trial discovery.[26]

8. Locality Rule: Historically, health care providers have been expected to render care consistent with the general standard of care in their community. Over time, because of improved communication and more uniform professional training, courts in many states have interpreted "community" quite broadly, encompassing regional if not national standards. There are two major reasons for dissatisfaction with this trend. First, many providers argue that this broad interpretation leads to the use of "hired guns"--providers who specialize in testifying on the plaintiff's behalf. Second, adherence to regional and/or national norms may require that many physicians conform their practices to higher standards which in turn result in more costly care. Several states during the mid-1970s adopted local standard of care and/or expert witness rules to limit the use of national standards and/or witnesses.[27]

Alternatives to Trial

1. Pretrial Screening Panel: During the mid-1970s, more than half the state legislatures established pretrial screening panels to which cases must be submitted before they proceed to trial. Statutes vary substantially in terms of panel composition, procedural details, and admissibility of findings at subsequent trial. Virtually no other "reform" has elicited as much challenge in the courts as the concept of pretrial screening, principally because the panels are viewed as interfering with a plaintiff's right to jury trial.[28] Irrespective of the constitutional issues, there is some reason to believe that panels may not be effective in terms of reducing premiums. First, rather than

substitute for the jury trial, the panel may add another layer because many cases are not settled during the pretrial hearing. Second, although proceedings of the panels are less formal than a full-scale trial, substantial legal expenses may be incurred, especially in states where decisions are admissible at trial. Third, the existence of an informal and initially less expensive adjudication mechanism may in itself encourage filing of claims.[29]

2. Binding Arbitration: Binding arbitration differs from pretrial screening in that the decision of an arbitration board is final; unlike screening, arbitration is not followed by a jury trial. Proponents of arbitration argue that it reduces malpractice costs by resolving disputes in a less formal setting and before a panel of experts rather than a jury, which not only is nonexpert but subject to emotionalism. These contentions are debatable.[30] Although, in principle, arbitration may be compulsory or voluntary, no state to date has mandated compulsory arbitration, probably because of doubts about its constitutionality.[31]

Insurance Provisions

1. Joint Underwriting Associations: Enabling legislation for the establishment of non-profit joint underwriting associations (JUAs) has been passed in the majority of states, but implemented in only a few. A JUA is a pooling arrangement composed of commercial liability insurers with business in the state. All JUA statutes require that premium rates be on a self-sustaining basis. If losses occur, member companies may be assessed to cover the deficit. In some states, assessments may be recouped by subtracting the assessment due to the state from the premium tax or by instituting a surcharge on premiums paid by providers. JUA surpluses are to be used for premium reductions. Statutes normally

expire two or three years after enactment; depending on state statute, the JUA may be the exclusive carrier or compete with others.[32] In some states where JUAs are monopolists, they have been subject to criticism by doctors for their high rates.[33] JUAs may be a better solution for the malpractice insurance availability problem than for the cost problem.

2. Health Care Mutual Insurance Companies: A few states have recently enacted legislation authorizing creation of physician-owned and operated insurance companies. These firms assess physician members a one-time special charge (about one year's premium) which is refundable if the company succeeds.[34] Presumably since these mutual companies are run by physicians, they have a particular incentive to control premium increases.

EMPIRICAL SPECIFICATION

Overview

The regression analysis is based on a time series of cross-sections covering the years 1974 through 1978 with the state as the observational unit. All continuous variables are expressed in logarithmic form; all binary variables enter linearly. Two alternative types of equations are specified: (1) premium levels, and (2) annual percentage change in premium levels. In the latter, the dependent variable is difference in the logarithm of premiums in a given specialty between year t and $t-1$. This difference (multiplied by 100) yields a percentage change. When the premium equation is in difference form, the regressions span 1975-78 (annual changes for 1974-75, 1975-76, 1976-77, and 1977-78).

Dependent Variables

Dependent variables are premiums paid by physicians in three fields--general practitioners who do no surgery, ophthalmologists, and orthopedic surgeons--deflated by a state price index that varies across states and over time (with 1967 = 1.0).[35] Premiums are for a "standard" policy offering $100,000/$300,000 coverage.[36]

Table 6-1 presents state means of premiums by year for the three groups of physicians. As seen in the table, premiums adjusted for cost-of-living differences peaked in 1976. The table shows that ophthalmologists' premiums grew relatively slowly. Nevertheless, premiums for various specialties in a state are highly correlated; pairwise correlations between general practitioner, ophthalmologists, and orthopedic surgeons are all 0.92 or higher; correlations between annual percentage changes in premiums in the three fields are also high, all 0.91 or higher. The correlations imply either that all the physicians in the state share the financial consequences of adverse experience of a few specialties or claim experiences among specialties within a state tend to move together. The former is far more likely.

Explanatory Variables

The focus of the regression analysis is on the impacts of legislative changes on levels and rates of change in malpractice premiums. To isolate the impacts of legal influences on the dependent variables, it is necessary to control for a number of other factors.

The model contains three control variables that are similar to variables included by Reder (1976) and Feldman (1979): per capita income (deflated by the state price index)--Y; surgical operations per 1,000 population--OPSPOP; and lawyers per 10,000 population--LAWPOP. In addition, the number of patient care physicians per 10,000 population--MDPOP--is included. Although a higher surgery rate may be expected to lead to a higher incidence o malpractice claims, a higher physician-population ratio may have the le 6-1. Growth of Malpractice Premiums: State Means

nium	1974	1975	1976	1977	1978	% Change 1974-76	% Change 1974-78
			Undeflated (current dollars)				
eral practice	432	647	808	858	879	87.0	103.5
thalmology	1,297	1,843	2,220	2,341	2,376	71.2	83.2
hopedic surgery	2,821	4,448	5,508	5,728	5,738	95.2	103.4
			Deflated (1967 dollars)				
eral practice	294	403	475	475	451	61.6	53.4
thalmology	889	1,149	1,310	1,300	1,225	47.4	37.8
hopedic surgery	1,913	2,763	3,246	3,178	2,958	69.7	54.6

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opposite effect since patient access improves with increases in the physician-population ratio. More specifically, patients' office waiting time falls and the length of time physicians spend with patients rises.[37] Thus, even if medically defined quality is not altered, patients may feel better about their doctors.[38] As an alternative variable to MDPOP, a variable indicating physician availability in the specialty corresponding to the premium was entered as an explanatory variable; results were virtually identical to those shown below.

When premiums are expressed as levels, it is appropriate to control for the legal environment prior to the mid-1970s. As noted above, enactment of specific laws on malpractice is a development of the mid-1970s. Thus, prior to this time, the disposition of malpractice cases was to a large extent dependent on the nature of tort law in the state, as determined by the state legislature and judiciary. Initial regressions contained a legal variable as constructed by Feldman (1979), similar to Reder's (1976), and, alternatively, a legal index based on parameter estimates from Feldman's regression with malpractice claims frequency as the dependent variable. Neither legal variable showed a discernible impact on premiums once other explanatory variables were included.

An alternative approach is to include individual state binary variables. This approach introduces multicollinearity. However, without a measure of the legal environment prevailing over a substantial period of time, parameter estimates on variables depicting state legislative responses may be biased.

Variables depicting legislative responses to the malpractice crisis of the mid-1970s are shown in Table 6-2 from LRECOV through SELINS. The

Table 6-2. Explanatory Variable Definitions, Means, and Standard Deviations

Variable Name	Definition	Mean	Std. Dev.
Y	Real per capita income	3717.0	503.0
OPSPOP	Surgical operations per 1,000 population	0.0812	0.0164
LAWPOP	Lawyers per 10,000 population	12.4	11.7
MDPOP	Patient care physicians per 10,000 population	13.0	4.4
LRECOV	Limitation on provider liability	0.18	0.38
LLIM	Limitation on recovery by plaintiff	0.23	0.42
PTCOMP	Patient compensation fund	0.18	0.38
RESIPS	*Res Ipsa Loquitur*	0.22	0.41
ICON	Informed consent	0.32	0.47
CONFEE	Contingency fee regulation	0.27	0.45
SLIM	Statute of limitation	0.50	0.50
CSOUR	Collateral source provision	0.24	0.43
ADDAM	*Ad damnum* clause	0.40	0.49
LOCAL	Locality rule	0.22	0.41
SCREEN	Pretrial screening panel	0.40	0.49
ARBIT	Binding arbitration	0.17	0.38
JUA	JUA major insurer in state	0.06	0.24
SELINS	Health care mutual insurance company implemented	0.08	0.28
T74	Year = 1974	0.19	0.39
T75	Year = 1975	0.20	0.40
T76	Year = 1976	0.20	0.40
T77	Year = 1977	0.20	0.40

variables assume the value one for the year a malpractice "reform" was enacted by the state legislature and for succeeding years and are zero otherwise with one exception. When a reform was subsequently overturned by judicial decision, the variable assumes the value zero in the year in which the decision was made and thereafter.[39] Correlations among the legislative change variables (shown in Table 6-5) are almost always positive and most often in 0.2 to 0.4 range. The highest correlation, not surprisingly, is between limitation on recovery and the patient compensation fund (0.63). Finally, time variables T74 through T77 represent time-related effects common to all states.

Several alternative specifications were explored in order to gauge the time phasing of responses to recent legislation and other explanatory variables, all using premium levels as the dependent variable. In one, a lagged dependent variable was included (Koyck lag specification). Results from these regressions imply that around 90 percent of the response to a change in an explanatory variable takes place in the year following the change, quite a rapid response. Alternatively, explanatory variables for both the current and the preceeding year were included in the same regression. The resulting parameter estimates were very unstable because of multicollinearity.

EMPIRICAL RESULTS

Table 6-3 presents regressions with premium level dependent variables. The first, second, and fourth regressions also contain individual state binary variables, not shown. The state binary variables should account for factors responsible for continued interstate differences in real premiums not explained by real per capita income (Y) through the physician-population ratio (MDPOP). If effective, legislative change variables

Table 6-3. Premium Level Regressions

Explanatory Variable	Dependent Variable							
	1. General Practitioner Premium		2. Ophthalmologist Premium		3. Orthopedic Surgeon Premium		4. Orthopedic Surgeon Premium	
Y	0.42	(0.66)	0.44	(0.70)	0.28	(0.34)	0.51	(0.71)
OPSPOP	1.016^c	(0.60)	1.11^c	(0.63)	-0.23	(0.44)	1.11^c	(0.64)
LAWPOP	1.020	(0.80)	1.31	(0.85)	0.88^a	(0.23)	1.04	(0.87)
MDPOP	-0.22	(0.87)	-0.49	(0.93)	0.25	(0.24)	0.17	(0.94)
LRECOV	-0.080	(0.088)	-0.027	(0.093)	0.019	(0.11)	-0.16	(0.09)
LLIM	0.046	(0.093)	0.046	(0.098)	0.11	(0.11)	0.024	(0.10)
PTCOMP	0.039	(0.10)	0.0005	(0.11)	0.11	(0.12)	0.046	(0.11)
RESIPS	0.001	(0.094)	-0.037	(0.010)	-0.088	(0.13)	0.052	(0.10)
ICON	-0.009	(0.085)	0.046	(0.090)	0.28^a	(0.11)	0.022	(0.091)
CONFEE	-0.011	(0.100)	0.013	(0.11)	0.24^b	(0.11)	-0.031	(0.11)
SLIM	-0.047	(0.072)	-0.020	(0.077)	0.016	(0.089)	0.0009	(0.078)
CSOUR	0.012	(0.094)	0.038	(0.099)	-0.15	(0.12)	-0.013	(0.10)
ADDAM	0.10	(0.087)	0.079	(0.084)	-0.15	(0.10)	0.13	(0.085)
LOCAL	0.18^b	(0.08)	0.11	(0.089)	0.069	(0.11)	0.093	(0.090)
SCREEN	-0.19^a	(0.07)	-0.19^a	(0.071)	-0.16^c	(0.09)	-0.15^b	(0.072)
ARBIT	0.26^a	(0.09)	0.29^a	(0.096)	0.25^a	(0.10)	0.18^c	(0.097)
JUA	0.13	(0.11)	0.080	(0.12)	-0.099	(0.16)	0.11	(0.12)
SELINS	0.16^c	(0.09)	0.048	(0.098)	0.31^b	(0.14)	0.13	(0.10)
T74	-0.21	(0.17)	-0.13	(0.18)	--	(--)	-0.18	(0.18)
T75	0.074	(0.14)	0.063	(0.15)	--	(--)	0.15	(0.15)
T76	0.09	(0.11)	0.077	(0.11)	--	(--)	0.15	(0.11)
T77	0.065	(0.061)	0.070	(0.065)	--	(--)	0.090	(0.07)
Constant	5.16		6.37		4.69		6.63	
	$R^2 = 0.87$		$R^2 = 0.84$		$R^2 = 0.36$		$R^2 = 0.86$	
	F(69,166) = 16.4		F(69,166) = 12.4		F(18,217) = 6.9		F(69,166) = 14.6	

Notes: a = statistically significant at the 1% level (two-tailed test).

b = statistically significant at the 5% level (two-tailed test).

c = statistically significant at the 10% level (two-tailed test).

should demonstrate negative effects on real premiums. As seen in Table 6-3, there are more positive than negative signs on coefficients of variables LRECOV through SELINS. The most consistently statistically significant coefficients are for screening panels (SCREEN), arbitration (ARBIT), and to a lesser extent, mutual insurance companies (SELINS). But only the screening variable shows a negative impact on premiums. The fact that the regression results are quite similar for the three specialties is not surprising in view of the high simple correlations among premiums in the three specialties.

Table 6-4 presents regressions with annual growth in premiums as dependent variables. All of the regressions' explanatory power is in the time variables T75 through T77. These coefficients imply a rapid rate of premium inflation during 1974-75, 38 percent, 31 percent, and 45 percent for general practitioners, ophthalmologists, and orthopedic surgeons, respectively, higher than the inflation rate during 1977-78, which, as already seen, was negative. (Real premiums declined.) The legislative variables, viewed collectively, have no impact on premium inflation. In fact, excluding the time variables, the F-statistic for the equation never exceeds 0.63, far below conventional levels of statistical significance. Regressions including changes in control variables real per capita income through the physician/population ratio, not shown, are similar to those reported in Table 6-4.

FURTHER DISCUSSION AND CONCLUSION

This study has considered several alternative sources of and solutions for the problem of medical malpractice premium inflation. Potential sources range from increased availability of attorneys, changing attitudes of juries, financial status of insurers, to the status of tort law in the states. Whereas many of the potential sources of premium inflation

able 6-4. Annual Change Regressions

xplanatory ariable	Dependent Variable					
	1. General Practitioner Premium		2. Ophthalmologist Premium		3. Orthopedic Surgeon Premium	
RECOV	-0.010	(0.064)	0.0001	(0.069)	-0.040	(0.070)
LIM	0.040	(0.066)	0.018	(0.072)	0.027	(0.072)
TCOMP	-0.012	(0.071)	-0.0003	(0.079)	0.014	(0.079)
ESIPS	0.043	(0.077)	0.040	(0.085)	0.089	(0.085)
CON	-0.056	(0.067)	-0.055	(0.073)	-0.057	(0.073)
ONFEE	0.0002	(0.06)	0.007	(0.071)	-0.018	(0.071)
LIM	-0.006	(0.053)	0.019	(0.058)	0.012	(0.058)
SOUR	0.007	(0.07)	0.030	(0.078)	0.018	(0.078)
DDAM	0.050	(0.061)	0.039	(0.067)	0.053	(0.067)
OCAL	0.032	(0.070)	0.012	(0.077)	-0.026	(0.077)
CREEN	-0.071	(0.053)	-0.081	(0.058)	-0.044	(0.058)
RBIT	0.11[c]	(0.06)	0.12[c]	(0.07)	0.074	(0.067)
UA	0.034	(0.092)	0.026	(0.101)	-0.011	(0.10)
ELINS	-0.009	(0.082)	-0.065	(0.090)	-0.060	(0.090)
75	0.38[a]	(0.07)	0.31[a]	(0.073)	0.45[a]	(0.073)
76	0.19[a]	(0.06)	0.17[b]	(0.07)	0.21[a]	(0.07)
77	0.064	(0.060)	0.069	(0.066)	0.076	(0.066)
onstant	-0.070		-0.075		-0.081	
	$R^2 = 0.21$		$R^2 = 0.14$		$R^2 = 0.23$	
	F(17,174) = 2.8		F(17,174) = 1.7		F(17,174) = 3.1	

otes: a = statistically significant at the 1% level (two-tailed test).

b = statistically significant at the 5% level (two-tailed test).

c = statistically significant at the 10% level (two-tailed test).

Table 6-5. Simple Correlations Among the Legislation Variables

	LRECOV	LLIM	PTCOMP	RESIPS	ICON	CONFEE	SLIM	CSOUR	ADDAM	LOCAL	SCREEN	ARBIT	JUA	SELINS
LRECOV	1.00	0.27	0.36	0.11	0.13	0.29	0.23	0.26	0.39	0.19	0.36	0.35	-0.02	0.10
LLIM		1.00	0.63	0.00	0.29	0.16	0.22	0.23	0.27	0.06	0.08	0.21	-0.01	0.08
PTCOMP			1.00	0.02	0.20	0.24	0.18	0.26	0.37	0.13	0.25	0.11	0.02	0.14
RESIPS				1.00	0.59	0.03	0.34	0.23	0.20	0.64	0.37	0.15	0.22	0.06
ICON					1.00	0.29	0.35	0.50	0.44	0.52	0.40	0.24	0.13	0.08
CONFEE						1.00	0.25	0.66	0.42	0.28	0.35	0.13	-0.07	0.26
SLIM							1.00	0.35	0.56	0.28	0.34	0.18	0.22	0.25
CSOUR								1.00	0.45	0.33	0.38	0.22	0.07	0.36
ADDAM									1.00	0.27	0.44	0.11	0.09	0.37
LOCAL										1.00	0.35	0.28	-0.00	0.14
SCREEN											1.00	0.19	0.24	0.31
ARBIT												1.00	-0.11	0.02
JUA													1.00	-0.07
SELINS														1.00

were national in scope, most deliberate action was undertaken at the state level.

As discussed in this study, states instituted a number of statutory changes aimed at reducing premiums, or at least the rate of increase, and guaranteeing availability of malpractice insurance coverage. The empirical results give no indication that individual legislative actions, or actions taken collectively, had their intended effects on premiums.[40] It is possible that the publicity resulting from considerable legislative activity made juries and perhaps potential plaintiffs more aware of the cost consequences of malpractice suits. If it existed, this effect probably extended beyond the boundaries of any particular state.

Another possibility is that frequency of claims and size distribution of settlements in a state are only weakly related to premiums in the state. Unfortunately, state-specific data on claims frequency and the dollar amounts of settlements are not available for 1974 or thereafter. However, correlations between 1974 premiums, claims filed, cases won by plaintiffs, and mean size of awards for 1970 are surprisingly low (0.3 or less).[41] Certainly adverse insurer experience in a given year should be reflected in higher premiums in later years so that higher correlations were expected. There is a need for more "hard" empirical evidence on how insurers really set premiums.

Finally, lawyers are often held accountable for the increased tendency to seek legal recourse. Even though the lawyer variable is insignificant in regressions containing the state binary variables, the sign on the lawyer coefficients remains positive and substantial in size. Without the state binaries, the lawyer variable is significant at the one percent level. Viewing the empirical evidence in its entirety, the notion that a 10 percent increase in the state lawyer/population ratio leads to almost a like percentage increase in premiums is a real possibility.

FOOTNOTES TO CHAPTER 6

[1] There are numerous accounts of legislative responses; a few studies document court decisions in this area. See, for example, Abraham (1977); American Arbitration Association (1976); American Medical Association, Office of the General Counsel (undated); American Medical Association, Public Affairs Division (1977a, 1977b, 1978); Baynes (undated); Carlin (1980); Editors of Duke Law Journal (1977); Jacobs (1977); Law and Polan (1978); Lipson (1976); Medical Liability Commission (1976); Medical World News (1977); Miike (1975); National Center for Health Services Research (1979); Redish (1977); Rhein (1976); Rosenberg (1980); Stromberg (1979); and Warren and Merritt (1976).

[2] Rosenberg (1979); Medical World News (1979).

[3] See especially All Industry Medical Malpractice Insurance Committee (1975) and Kendall (1978).

[4] Greenspan (1979), p. 66.

[5] Source: Unpublished data from Nancy Greenspan, Health Care Financing Administration; premiums are for a standard $100,000/$300,000 policy.

[6] See Greenspan (1979), p. 66 for 1974-77 trends. I have calculated the 1977-78 change. Pre-1974 data on premiums are available from Kendall (1978), p. 176.

[7] See, for example, U.S. Department of Health, Education, and Welfare (1978), Table 4-18 and Henderson (1978), p. 10.

[8] See, for example, Rudov, et al. (1973), p. 9, and U.S. Department of Health, Education, and Welfare (1978), several tables.

[9] Both Reder and Feldman took their legal variables from Dietz, et al. (1973).

[10] See, for example, Hastings (1975), All Industry Medical Malpractice Insurance Committee (1975), Munch (1978), and Law and Polan (1978).

[11] Law and Polan (1978), p. 171.

[12] See, for example, Rosenberg (1979).

[13] See, for example, American Medical Association (1978).

[14] More comprehensive summaries are provided in sources listed in note 1.

[15] See Editors, Duke Law Journal (1977) and Editors, Northwestern Law Review (1966).

[16] Editors, Duke Law Journal (1977), p. 252; American Medical Association (1977a), p. 7.

[17] U.S. Department of Health, Education, and Welfare (1978), p. V-7.

[18] All Industry Medical Malpractice Insurance Committee (1975).

[19] U.S. Department of Health, Education, and Welfare (1978), p. V-6.

[20] Exceptions are listed in Editors, Duke Law Journal (1977), pp. 254-255.

[21] See, for example, Dietz, et al. (1973) and American Surgical Association (1976).

[22] Feldman (1979).

[23] See Editors, Duke Law Journal (1977), p. 268.

[24] See American Medical Association (1977a), p. 4.

[25] Abraham (1977), pp. 504-505.

[26] American Medical Association (1977a), p. 2.

[27] For further discussion, see Abraham (1977).

[28] Recent court cases are listed in American Medical Association (1978). See Holder (1978), pp. 408-413, for a description of screening panels.

[29] Abraham (1977), p. 516.

[30] Abraham (1977), p. 517. Arbitration panels may in fact be more lenient. See Wadlington (1973). More favorable empirical evidence on cost-effectiveness of arbitration is presented in Heintz (1977). Arbitration has encountered opposition from trial lawyers. See Rosenberg (1980), p. 163.

[31] See Redish (1977), p. 768.

[32] See American Medical Association (1977a), p. 10.

[33] Rhein (1976), p. 75.

[34] See American Medical Association (1977a), p. 11 and Medical World News (1977), p. 23.

[35] The state price index is described in Sloan (1975).

[36] Premium data come from the Telephone Survey of Malpractice Insurance Companies conducted by the Health Care Financing Administration. See Greenspan (1979) for a capsule description of the survey. The first figure of the liability limit ($100,000 above) represents the annual limit per case; the second is the annual limit for all cases against the provider.

[37] Sloan and Lorant (1976, 1977) and Applied Management Sciences (1980).

[38] It is also true that utilization rates rise. To the extent that some "unnecessary" care is given, patients may be more likely to sue.

[39] Legislative change variables are based on sources listed in note 1 above.

[40] Many observers at the time were quite optimistic. See, for example, Welch (1975).

[41] The 1970 data were used in Feldman (1979). I am grateful to Roger Feldman for making these data available for this study.

SECTION IV

THIRD PARTY PAYOR REIMBURSEMENT PRACTICES

Chapter 7

Physicians and Blue Shield: A Study of Effects of Physician Control on Blue Shield Reimbursements

Frank A. Sloan

INTRODUCTION

Increasingly, actions by a variety of occupational interest groups that were once justified as ways of protecting the public interest are now held to be ways of furthering the financial interests of the occupations themselves. Professional fields, such as law, medicine, and optometry, which heretofore enjoyed de facto exemptions from U.S. antitrust laws, have come under considerable scrutiny from both legislative and judicial branches of government in the 1970s. Unfortunately, much of the evidence furnished by the prosecution in cases involving these professional groups has related to structure or process rather than to market outcomes.

In the context of physicians' relations with Blue Shield, evidence of the structure-process variety encompasses physician participation on Blue Shield boards, organized medicine's role in Blue Shield board selection, and various statements in letters and in Blue Shield brochures indicating a physician-Blue Shield nexus. Outcome-speicifc measures refer to Blue Shield payments to physicians for specific procedures, quantities of services rendered to Blue Shield subscribers, and the like. Evidence linking structure-process to outcomes merits far more weight in antitrust inquiries than structure and process alone.[1] But such evidence has generally been lacking in antitrust inquiries in medical care markets.

In 1976, 75 percent of outlays on personal health care were financed by third parties.[2] Blue Cross-Blue Shield are by far the largest single private insurers; in 1975, they had about half of the private insurance business in the U.S.[3] While it is incorrect to characterize Blue Cross or Blue Shield as national non-profit insurance firms since local Blue Cross and Blue Shield plans have considerable autonomy, the Blues have the largest market share of any single insurer in the vast majority of states.

Any major public policy action designed to foster competition in the medical marketplace via health insurers would almost inevitably involve rulemaking and changes in the health insurance regulatory apparatus. Such changes are not costless. Not only could various new rules impose costs on insurers, but, more importantly, given the absence of empirical evidence on how existing relationships between insurers and health care providers affect market performance, policy actions in this sphere could easily be misplaced. Policymakers could conceivably lose valuable time "barking up the wrong tree."

This study assesses the impacts of specific Blue Shield-organized medicine linkages on levels of reimbursement for various medical and surgical procedures and on physician willingness to participate in Blue Shield service benefits programs. The empirical analysis shows that Blue Shield reimbursements and participation rates are higher when doctors have formal roles in plan decisionmaking. The results on participation, in combination with evidence from previous research, establish a link from control to higher Blue Shield reimbursements to greater physician willingness to accept Blue Shield patients on a payment-in-full basis and reductions in care to persons eligible for public program support, in particular Medicaid. Impacts on physicians' fees, though not documented empirically, are quite likely. Certainly a strong theoretical case can be made for such impacts.

The next section presents pertinent background information. This is followed by the theoretical framework, description of data, and empirical specification. Results and implications from the empirical analysis are found in the final two sections.

BACKGROUND

There is a clear historical connection between Blue Shield plans and state and local medical societies as is also the case between Blue Cross and state-local hospital associations. In 1939, the California Medical Association and the Michigan State Medical Society were instrumental in organizing the first Blue Shield plans. At the outset, Blue Shield plans in these states and elsewhere were controlled by physicians. The local medical society often advanced the initial capital for a plan (Reed, 1947). At the same time, individual doctors "underwrote" plans by agreeing to treat Blue Shield subscribers, especially those with low incomes, for amounts less than their "usual" fees. State Blue Cross-Blue Shield enabling acts, which give the Blues both non-profit status and some tax advantages over the commercials (Frech, 1974), have often required that plans be subject to medical society approval or that a majority of the board of directors be physicians (Reed, 1947; Somers and Somers, 1961). The importance of the tax advantages has been debated, but not yet settled.[4]

Until recently, when such statements have become both politically and legally sensitive, documents from physician organizations and Blue Shield plans often referred to the plans as the "economic arm of the profession"[5] or, in a more altruistic vein, as "the doctor's plan--for the people."[6] Instances of anticompetitive practices by Blue Shield and organized medicine, such as boycotts of cost-conscious insurers and/or individual physicians engaged in price-cutting activities, have been documented.[7] Moreover, potential punitive actions may be sufficient to deter competition on the basis of price.

Two other key features have characterized Blue Shield plans as a group throughout much of their history: service benefits and community (as opposed to experience) rating. Only the first of these is directly pertinent here.[8] Under a service benefit plan, the insurer promises covered patients a bundle of "free" services (zero copayment for specific services rendered); the physician accepts the insurer's reimbursement as payment-in-full and collects his payment directly from the insurer. Alternatively, under indemnity plans, typically used by commercial insurers and sometimes by Blues "as a competitive response" to the commercials, the insurer pays a fixed amount for a specific procedure. The physician may (and frequently does) bill the patient for charges in excess of the third party payment. As a rule, under indemnity, the patient is responsible for collecting from the third party. All physicians need do is complete a form describing services rendered.

Agreements by physicians to participate in Blue Shield service benefit programs roughly fall into two categories: those in which individual physicians themselves decide their participation status; and those in which the participation decision is made collectively, i.e., through medical society membership agreement. Individual agreements are about three times as numerous as medical society endorsements (unpublished correspondence with Blue Shield Association). When physicians have the option of participating, a recent study indicates that 28 percent of office-based physicians declined to do so.[9]

Analytically, a number of alternative models could depict ties between the plans and doctors. The notion that at least some Blue Shield plans could be characterized as producers' cooperatives was advanced by Louis Reed in 1947. By contrast, there is evidence of some controversy between Blues and medical care providers, and some plans may conceivably reap monopsony profits by "exploiting" physicians.[10] The latter view is admittedly incomplete, given the plans' non-profit status. Possibly a non-profit monopsonist spends its profits on emoluments to management, as Blair, et al. (1975) have suggested and/or profits may be spent promoting the Blue Shield philosophy. Still another model postulates a bilateral monopoly with Blue Shield and organized medicine on opposite sides.

ANALYTIC FRAMEWORK

Several models may be appropriate for analyzing price and output behavior of Blue Shield plans; for each, I assume that Blue Shield sells a single product, a full coverage health insurance policy. As an intermediary, the plan performs two functions. First, it enrolls families, and second, it contracts with physicians to provide services to Blue Shield on a payment-in-full basis. By deciding on the number of families to enroll and the quantity of services to purchase from physicians, the plan determines services per enrollee or, equivalently, the quality of its product.

Assume the Blue Shield plan faces the following hedonic premium function:

(7-1) $p = p(r;\alpha)$, where

p = premium
r = quantity of services provided on a payment-in-full basis (q) divided by number of enrollees (e)
α = any exogenous demand factor accounting for vertical shifts in $p(\cdot)$.

As specified in (7-1), the plan is a price-taker in its product market, a simplifying assumption with no qualitative effects on predictions. With a higher ratio of services to enrollees, the plan can charge a higher premium ($p_r > 0$). Even as specified, $p(\cdot)$ is downward-sloping in e in that, holding q constant, the plan has to lower p as it adds enrollees. Such exogenous demand factors (which vary among areas) as community income per capita, educational attainment, family structure, urbanization, and unionization affect the amount of premium paid for a given level of quality.[11]

Further assume, in any community, there is an upward supply curve relating the quantity of services physicians are willing to supply to Blue Shield on a payment-in-full basis to the payment they receive per unit of physician output (g).

(7-2) $g = g(x;\gamma)$, where

g = fee schedule
x = quantity of physicians' services sold to plan
γ = any exogenous factor shifting the supply curve.

The supply curve slopes upward for this reason. At low g, only low quality doctors are attracted to the plan; others sell their output elsewhere; as g rises, higher quality doctors agree to treat Blue Shield patients. Examples of variables included in γ are wages paid nonphysician personnel and the percentage of doctors with degrees from "third world" countries in the community. Higher wages and a lower third world percentage shift (7-2) inward.

The production function for the plan is

(7-3) $q = q(x,z)$, where

q = quantity of services provided Blue Shield enrollees
z = quantity of administrative input, including claims clerks, insurance sales personnel.

At one extreme, the Blue Shield plan exercises monopsony power over community physicians. Then, the plan's profit function is

(7-4) $\pi = p(r;\alpha)e - g(x;\gamma)x - vz$, where

e = number of families enrolled in plan
v = price of administrative input.

Given (7-4), the plan determines optimal levels of x,z, and e. Input and enrollment levels in turn determine the quality of Blue Shield policy (r) and the premium (p).

Maximizing π, the first order conditions are

(7-5) $\pi_x = p_r q_x e - g_x x - g(\cdot) = 0$

(7-6) $\pi_z = p_r q_z e - v = 0$

(7-7) $\pi_e = p_r r_e e + p(\cdot) = 0$

Equation (7-5) gives the profit-maximizing condition for the monopsonist, namely the quantity of x purchased occurs at point where the marginal factor cost ($g_x x + g$) equals the marginal revenue product ($p_r q_x e$). The difference from the standard textbook case is that marginal revenue product refers to extra units of product quality rather than quantity. Since the market for z is competitive, equation (7-6) states that optimal z occurs where the marginal revenue product from expanding quality equals v. According to (7-7), enrollment is set at the point where selling further policies would lower total plan revenue (marginal revenue = 0).

Collective action by community physicians may offset Blue Shield's monopsony power. Bilateral bargaining models involving a single buyer and seller of an input yield indeterminate predictions. Outcomes depend on (1) seller preferences, in this case the local medical society, (2) the relative bargaining power of the buyer and seller, and (3) bargaining strategies pursued by the parties.[12] Three bilateral monopsony approaches (not the only ones) are depicted in Fig. 7-1. First, the seller may attempt to maximize the dollar surplus above the reservation price (g). To accomplish this, the seller sets x at the intersection of a curve marginal to the plan's demand for physician labor curve (MRP') and the physician supply curve (AFC). Using this strategy, the seller attempts to sell x_B for g_B, but, as drawn, g_B is unattainable without bankrupting the plan. This, of course, need not be the case.

A second seller strategy involves bargaining for a higher wage at the monopsonist physician input level x_A. In Fig. 7-1, the doctors would try for g'_B (but as before, as drawn, would encounter a bankruptcy constraint before reaching g'_B). Third, a local medical society interested in spreading Blue Shield monies to a large number of its members might set x at x_C. There, Blue Shield's monopsony power is fully offset. In contrast to such points as B and B', C like A is located on the supply curve. Given that there is absolutely no evidence that the privilege of participating in a Blue Shield program is limited by local medical societies or anyone else, the equilibrium solutions A and C are much more plausible than B and B' or any other scenario in which excess supply of x prevails.

At the other extreme, doctors run Blue Shield as a doctor's cooperative, maximizing the difference between premium income and costs and distributing the residual among themselves. In one highly implausible case, doctors maximize the difference between $p(\cdot)e$ and vz. Then equilibrium x and g are x_D and g_D. But this solution is implausible. In setting x_D where MRP equals zero, the doctors value their own time at zero.

More plausible, the cooperative sets x and g at the point of intersection between the supply curve and the net average revenue product curve (NARP), where NARP $= [p(r;\alpha)e - vz]\frac{1}{x}$. Then

$$(7\text{-}8)\quad L = g(\cdot)x + \lambda[p(\cdot)e - g(\cdot)x - vz]$$

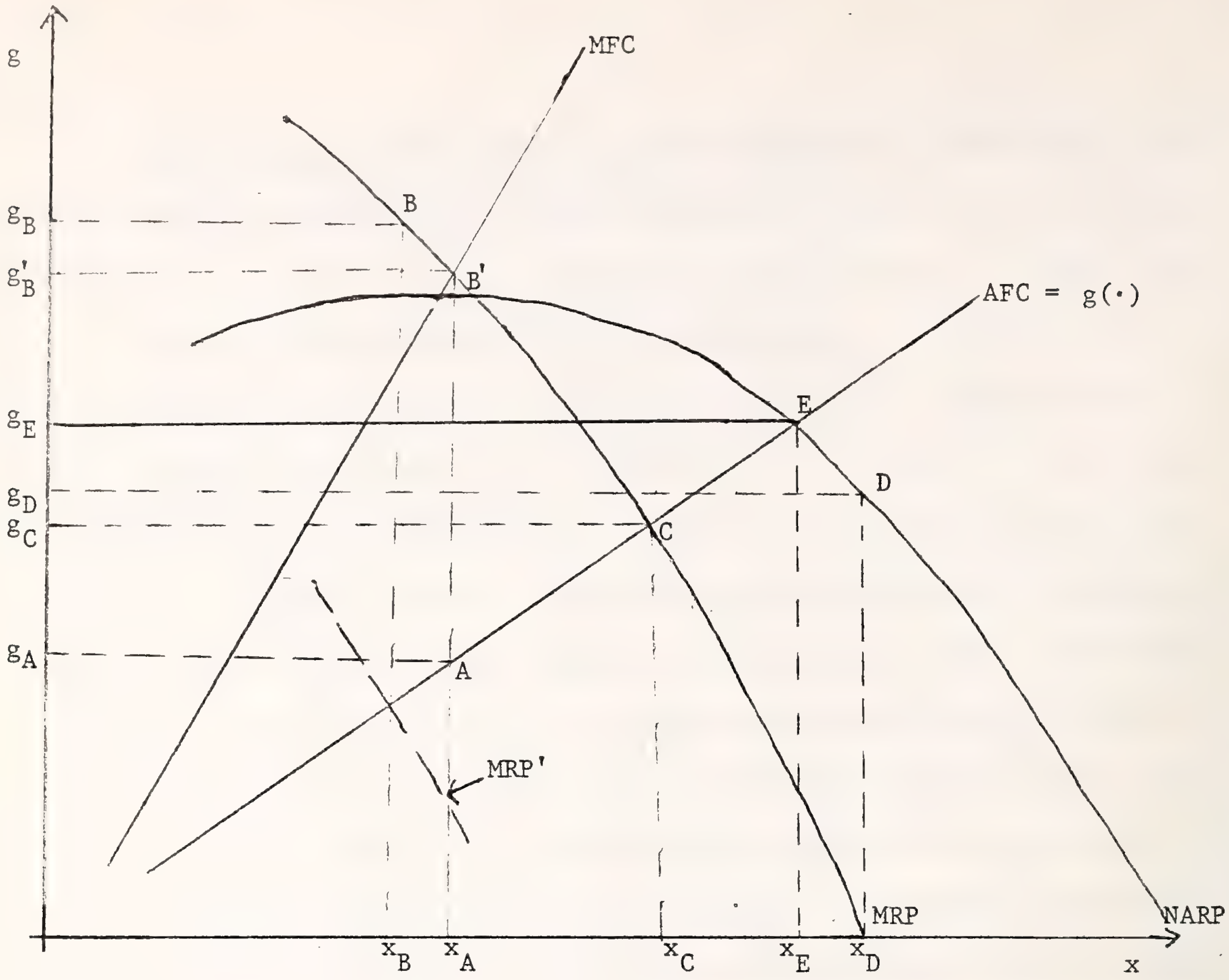

Figure 7-1: Alternative Models of Blue Shield Plan Behavior

The first order conditions for z and e are identical to the Blue Shield monopsonist case. The derivative $\frac{dL}{d\lambda}$ states that equilibrium occurs at E in Fig 7-1.

$$(7\text{-}9)\quad \frac{dL}{dx} = g_x x + g(\cdot) + \lambda[p_r q_x e - g_x x - g(\cdot)] = 0$$

Since MFC exceeds zero, λ must be positive to satisfy (7-9). In equilibrium, according to (7-9), MFC exceeds MRP at E in Fig. 7-1.[13] Input level x_E for the physicians' cooperative exceeds x_A, the physician input level chosen by a Blue Shield monopsonist.

In sum, knowledge of the relevant institutions in combination with theory leads to two implications: First, irrespective of who controls Blue Shield, equilibrium should occur along the community physician supply curve $g(\cdot)$ and second, as physicians gain control relative to Blue Shield management, both x and g rise. Hence, an empirical test of the above should show that descriptors of physician control have systematic impacts on both fee schedules and physician inputs. For this reason, regressions with both measures of g and x as dependent variables are specified below.

Comparative statics analysis on the monopsony and physician cooperative equilibrium models yields ambiguous predictions about impacts of changes in α and γ on x and g.[14] However, sources of ambiguity are similar. Hence there is no reason to believe that the exogenous shift variables should behave in qualitatively different ways depending on who controls Blue Shield.

Finally, a competitive insurance market has been assumed. As the previous section's discussion implies, there is ample reason to believe that the health insurance market contains important monopolistic elements. However, as we have just seen, even in a competitive product environment, with a doctor-controlled plan, x and g rise as the plan offers a higher quality product. Assuming that the Blue Shield plan faces a downward-sloping demand curve for its product would not alter this conclusion.

DATA

The core data base for this study comes from a nationwide survey of 2,024 private-practice fee-for-service physicians undertaken by the NORC during late 1975 and 1976. This survey, sponsored by HCFA, precedes the two surveys on which most of the empirical work in this report is based. The sample was restricted to physicians in the largest fields: general-family practice, general surgery, internal medicine, obstetrics-gynecology, and pediatrics. Items covered pertain to practice inputs, outputs, prices, costs, and third party reimbursement--including third party payment levels for various procedures and administrative burdens imposed on physicians by different types of insurers.

The interviews consist of a national survey of 1,014 and a regional survey of another 1,010 physicians. The national survey, conducted in 32 Primary Sampling Units (PSUs) throughout the U.S., is the more comprehensive of the two; interviews lasted up to 90 minutes. The regional survey, based entirely on 20 PSUs in the Mid-Atlantic (New Jersey, New York, and Pennsylvania) and East South Central (Alabama, Kentucky, Mississippi, and Tennessee) Census Divisions, used a survey instrument about half the length of the national's. Final response rates were 66 and 71 percent for the national and regional samples, respectively, or 68 percent overall. General surgeons, obstetricians-gynecologists, and pediatricians are slightly overrepresented in the sample because of higher response rates with corresponding underrepresentation among general practitioners and internists. Foreign medical school graduates, board-certified, and older physicians were somewhat more willing to respond.

For purposes of this study, the national and regional samples have been combined, using a weighting algorithm designed by NORC to eliminate overrepresentation of the two regional survey Census Divisions and to arrive at the appropriate number of effective degrees of freedom (which is always considerably less than 2,024). PSUs correspond to Standard Metropolitan Statistical Areas in the case of metropolitan areas and counties or clusters of counties in the case of nonmetropolitan areas.

Since one can identify the physician's county, area data corresponding to the physician's county were merged with the survey file when possible. Data on Blue Shield characteristics correspond to the Blue Shield plan area in which the physician practices. The NORC survey includes physician respondents from 27 of the 69 Blue Shield plans. The 27 are considerably larger than average; although our empirical analysis includes only 39 percent of the plans, the included ones encompass 69 percent of the U.S. population. In terms of measures of physician control, the 27 are precisely comparable to the 69 plans on some criteria (e.g., medical society approval of the plan) and somewhat less subject to physician involvement on others.[15] In one instance (union coverage), state data were used. Finally, biographical data on survey respondents from the American Medical Association was merged with the NORC data. The individual physician is the observational unit in all regressions.

EMPIRICAL SPECIFICATION

Dependent Variables

Empirical counterparts of g and x in the following reduced form regressions are measures of the amount Blue Shield pays the physician for specific procedures under its most generous reimbursement programs and a binary variable that equals one if the physician participates in the Blue Shield service benefit program.[16]

Blue Shield payment data are available for follow-up hospital and office visits, hernia repairs, diagnostic D and Cs, complete blood counts, and electrocardiograms.[17] If the Blue Shield plan paid the doctor different amounts for a given procedure, the doctor was requested to give amounts reimbursed under the most generous plan. All monetarily-expressed variables in this study, including the measures of g, have been deflated by an area cost-of-living variable.[18] As seen in Health Policy Center (1979), there is substantial intraplan variation in amounts paid individual physicians for specific procedures.

The survey asked physicians which of the following best described their current participation status: (1) participating and have signed a participation agreement (with the Blue Shield plan); (2) participating on a case-by-case basis; (3) participating on the basis of county or state medical society endorsement; (4) not participating; (5) no patients covered by Blue Shield insurance; (6) service benefit-participation arrangement not available in the physician's area; (7) physician bills at Blue Shield payment rate but has not signed a participation agreement. The dependent participation variable in the regressions presented below is one if the physician gave either the first, third, or seventh responses and is zero if he gave either the fourth or sixth responses. Observations in which the physician said he participated on a case-by-case basis or there were no Blue Shield patients in the locality were eliminated from the participation regressions.[19]

Explanatory Variables

Explanatory variables fall into these categories: (1) characteristics of Blue Shield plans; (2) exogenous demand for service benefit insurance variables; (3) exogenous determinants of the physician supply curve facing Blue Shield; and (4) individual physician characteristics.

Blue Shield Characteristics. Based on a reading of individual plans, the Federal Trade Commission (1979) classified Blue Shield plans according to the degree of organized medicine's involvement in Blue Shield plan board selection. The FTC developed four categories: (1) medical involvement in selecting less than 50 percent of the board members; (2) medical involvement in selecting 50 percent or more of board members; (3) self-perpetuating boards in which there is no apparent formal medical involvement in board selection; and (4) plans that fit in none of the above three groups, i.e., those with no apparent formal medical involvement, past or present, in board selection. In the "none apparent" group, boards are selected, for example, by corporate members and/or subscribers. The second group may be expected to rank highest in terms of physician control, followed by the first, third, and fourth. Although self-perpetuating boards do not reflect direct current influences of organized medicine, they may be linked to physicians' groups by appointments made in the past. In this analysis, binary variables BD49, BD51, and BDSP identify the first three groups with "none apparent," the reference category.[20]

A second dimension of physician control pertains to the occupational composition of Blue Shield boards. *Ceteris paribus*, a higher percentage of physician board members should be associated with a higher degree of physician control. Even though board composition is conceptually distinct from medical societies' power to make board appointments, in practice, the two are closely related. In only 2 of the 11 plans[21] in which medical societies appoint a majority of board members was there a minority of physician board members; the correlation between BD51 and the percentage of physicians on boards is 0.84. For this reason, the latter variable has been excluded from the regressions. Parameter estimates on the BD51 variable reflect the influence of board appointment methods and the occupational mix of the board (and perhaps other unspecified dimensions of control as well).

Third, individual Blue Shield plans have special committees, a majority of whose members may be physicians, responsible for some or all of the following five functions: review and modification of fee schedules; review of medical claims requiring individual consideration and establishment of claims administration policy; review of criteria for determination of reasonable charges; adjudication of fees exceeding "usual-customary-reasonable" (UCR) payment criteria; and review and/or participation of utilization review.[22] The binary variable COM is one if physicians have control over all five committee functions. Physicians have control over some of the above committees in all plans, but they have a majority in only about two-thirds of them.[23]

Fourth, as of 1977, 58 of 69 plans had formal medical society approval. Lack of approval may be indicative of lack of continuing support of organized medicine of the local Blue Shield plan. The binary variable MSOC is one for plans with formal medical society approval.[24]

Demand Shift Variables. Past empirical research suggests a number of potential determinants of consumer demand for complete insurance coverage, empirical counterparts of α. In preliminary regressions, variables representing per capita income, unionization, percentages employed in argiculture and manufacturing, and racial minority and female head of household percentages were included as explanatory variables. Many of these had significant impacts on the dependent variables. Only three, per capita income (Y), agricultural employment as a percentage of total employment (AGR), and union enrollment as a percentage of the nonagricultural workforce (UNION) are retained in the regressions presented below.[25]

Supply Shift Variables. A substantial number of variables (counterparts of γ) may be expected to shift the supply curve $g(\cdot)$. Among these are descriptors of physicians in the area: credentials of physicians, such as specialization, faculty affiliation, type of medical school attended and board certification status; personal characteristics of the physicians systematically related to physicians' time prices; and prices of non-physician inputs. Income (Y), included above, could also shift $g(\cdot)$ since doctors can command higher fees from non-service benefit patients in areas with high Y.[26] Some of these supply variables have been eliminated from consideration because (1) they are only available for the national sample or (2) they proved to have no discerible impacts on the dependent variables or were collinear with included explanatory supply variables. Three variables in addition to Y represent the supply component: percentage of physicians in the area who are aged 60 years and over (CAGE); percentage of physicians who are graduates of a foreign medical school in a non-English-speaking, non-Western European country (CFMG),[27] and an index of weekly wage rates of non-physician personnel in physicians' practices (WAGE), all defined for the PSU.[28] The HCFA-NORC survey collected wage data on all nonphysician employees in the practice. For coding purposes, nonphysician occupations were grouped into 10 occupational categories. Indexes by PSU were constructed using the national distribution of personnel in the 10 categories as weights.

Individual Physician Characteristics. Even though a Blue Shield plan's payment, or distribution of payments, for specific procedures is likely to reflect characteristics of physicians in the area, payment levels vary substantially within (as well as between) plan areas; in part, these within-area variations are intentionally designed to reflect differences in physicians' credentials. For example, a plan may explicitly recognize specialty or the payment may reflect the physicians' usual charges to other patients. To the extent that prestigious credentials are not recognized for reimbursement purposes and non-Blue Shield patients are willing to pay more to physicians with these added qualifications, a lower proportion of the less qualified physicians will be willing to accept Blue Shield payment as payment-in-full. Credentials variables, included in both payment and participation regressions, specified for the individual physician are: SPEC = 1 if the physician is a specialist; BCERT = 1 if the physician is board certified in a specialty; FAC = 1 if the physician has a medical school faculty appointment; AGE = 1 if the physician is age 60 or more; and FMG = 1 if the physician is a graduate of a foreign medical school in a non-English-speaking, non-Western European country.

Several other exogenous supply variables are available from the national but not the regional NORC survey: PY = 1 if the physician (and his family) had income, other than from the practice of medicine, amounting to more than $10,000; MAR = 1 for married physicians; HL = 1 if the physician reported that he has had to shorten his workweek or change the pace of his practice because of his health; and CH = number of children ages 18 and under of female physicians.[29] Each of the latter four variables is likely to be positively associated with the physician's shadow wage (for market work). Since these variables are only available from the national survey, the sample is greatly reduced when they are included. For this reason, they appear only in a variant of the participation regression.

The sample sizes for the payment level regressions are substantially smaller. To include the latter four variables in these regressions would result in an inadequate sample.[30]

EMPIRICAL RESULTS

Nature of Samples

Table 7-1 presents concise variable definitions and sample means and standard deviations for the combined national-regional sample and for the national sample only. Overall, the two samples are quite similar. As seen in Table 7-1, half or more of the physicians in the samples practiced in Blue Shield plan areas in which the medical society appointed a majority of members to the board. A majority of sample members practiced in plan areas where physicians controlled all five committees, and a vast majority in areas in which the medical society approved the plan. Another notable characteristic of both samples is overrepresentation of physicians age 60 and over.

Blue Shield Payment Regressions

Table 7-2 contains payment regressions for six procedures. Numbers in parentheses are standard errors; those in brackets are the coefficient as a fraction of the mean of the dependent variables in the case of binary explanatory variables; otherwise (for continuous explanatory variables) they are elasticities evaluated at the observational means. The regressions explain from 15 to 31 percent of the variation in the dependent variables. Judged in terms of statistical significance, the "best" variables pertain to Blue Shield plan characteristics, per capita income, and specialty status.

Above, we ranked the medical society board appointment variables from highest degree of control, BD51, to lowest, "none apparent," the

Table 7–1 Concise Variable Definitions, Means, and Standard Deviations

Variable	Definition	Sample Means and Standard Deviations[h] National-Regional Sample	National Sample
Dependent Variables			
Blue Shield payments:			
Followup hospital visit[a]		10.77 (3.92)	-- (--)
Followup office visit fee[a]		8.51 (3.75)	-- (--)
Inguinal hernia repair[a]		256.33 (64.91)	-- (--)
Diagnostic D and C[a]		118.65 (39.04)	-- (--)
Complete blood count[a]		6.60 (3.04)	-- (--)
Electrocardiogram[a]		17.20 (4.86)	-- (--)
Participation	yes = 1	0.77 (0.42)	0.78 (0.41)
Explanatory Variables			
BD49	Medical society appoints less than 50% of board[b]	0.25 (0.43)	0.24 (0.42)
BD51	Medical society appoints 50% or more of board[b]	0.54 (0.49)	0.50 (0.50)
BDSP	Board self-perpetuating[b]	0.09 (0.27)	0.05 (0.23)
COM	Physicians control all 5 committees[b]	0.65 (0.47)	0.64 (0.48)
MSOC	Medical Society formally approves plan[b]	0.92 (0.27)	0.96 (0.20)
Y	Per capita income [a,c]	4771. (564.)	4801. (533.)
UN	Percent of non-agricultural employees unionized[d]	26.2 (10.6)	-- (--)
AGR	Percent of total employment in agriculture[c]	4.0 (5.4)	-- (--)
W	Index of wages of non-physician personnel[e]	3.88 (0.39)	3.88 (0.38)
CAGE	Percent of physicians 60 years and older[e]	29.5 (14.5)	29.5 (14.4)
CFMG	Percent foreign medical school graduates[e,f]	9.3 (6.8)	9.5 (6.5)
SPEC	Physician is specialist (self-designated)[g]	0.64 (0.48)	0.64 (0.48)
BCERT	Physician is board certified[g]	0.43 (0.50)	0.44 (0.50)
FAC	Physician has faculty appointment[g]	0.10 (0.30)	0.08 (0.28)
AGE	Physician is 60 years or older[g]	0.30 (0.46)	0.30 (0.46)
FMG	Physician graduate of foreign medical school[f,g]	0.10 (0.30)	0.10 (0.30)
CH	No. of children of female physicians[g]	-- (--)	0.03 (0.28)
MAR	Physician is married[g]	-- (--)	0.91 (0.28)
PY	Physician has $10K+ in nonemployment income[g]	-- (--)	0.17 (0.38)
HL	Physician has health problem[g]	-- (--)	0.16 (0.36)

Notes:
- a. Deflated
- b. Defined for physician's Blue Shield plan area.
- c. Defined for physician's county.
- d. Defined for physician's state.
- e. Defined for physician's PSU.
- f. Concise definition may be misleading. See text.
- g. Defined for the individual physician.
- h. The Blue Shield payment means and associated standard deviations correspond to the payment regressions in Table 2. The means and standard deviations for UN and AGR are from the hospital and office visit regressions, respectively. Otherwise, the means and standard deviations are from the samples used to estimate the probit regressions presented in Table 3.

Table 7-2 Blue Shield Payment Regressions

Reg. No.	Dependent Variable	Explanatory Variables																
		BD49	BD51	BDSP	COM	MSOC	Y	UN	AGR	W	CAGE	CFMG	SPEC	BCERT	AGE	FMG	Constant	
1.	Followup hospital visit	1.30[a] (0.44) [0.12]	1.65[a] (0.46) [0.15]	0.045 (0.57) [0.00]	-0.29 (0.33) [-0.03]	0.74[c] (0.56) [0.07]	0.0013[a] (0.0003) [0.57]	0.018 (0.018) [0.04]	-- (--) [--]	0.76[c] (0.40) [0.28]	-0.018 (0.012) [-0.05]	-0.034 (0.024) [-0.03]	1.05[a] (0.33) [0.10]	0.64[b] (0.32) [0.06]	-0.27 (0.30) [-0.03]	-0.58 (0.43) [0.05]	-0.31 (--) [--]	R^2=0.15 F(14,861) =10.9
2.	Followup office visit	1.05[c] (0.63) [0.12]	2.40[a] (0.56) [0.28]	1,29[c] (0.69) [0.15]	2.57[a] (0.38) [0.31]	0.50 (0.71) [0.06]	0.00093[a] (0.00032) [0.51]	-- (--) [--]	-0.028 (0.037) [-0.01]	1.44[a] (0.41) [0.66]	0.033[b] (0.014) [0.11]	-0.17[a] (0.03) [0.16]	1.34[a] (0.36) [0.16]	0.53 (0.36) [0.05]	0.50 (0.32) [0.06]	-0.34 (0.54) [-0.04]	-6.17 (--) [--]	R^2=0.31 F(14,518) =16.5
3.	Inguinal hernia repair	4.89 (14.27) [0.02]	11.52 (12.99) [0.04]	-40.45[b] (17.77) [-0.16]	26.67[a] (10.14) [0.10]	14.41 (17.21) [0.06]	0.033[a] (0.009) [0.62]	-- (--) [--]	4.82[a] (1.39) [0.05]	17.75 (16.44) [0.27]	0.42 (0.47) [0.04]	-1.58 (0.84) [-0.06]	21.06[c] (12.64) [0.08]	20.90[b] (10.69) [0.08]	-13.26 (9.64) [-0.05]	6.75 (14.07) [0.03]	-30.09 (--) [--]	R^2=0.26 F(14,220) =5.5
4.	Diagnostic D and C	12.17[c] (6.26) [0.10]	10.29 (6.69) [0.09]	-8.07 (8.83) [-0.07]	10.55[b] (4.79) [0.09]	-9.19 (8.49) [-0.08]	0.012[a] (0.004) [0.48]	0.21 (0.26) [0.04]	-- (--) [--]	30.79[a] (5.86) [0.92]	-0.033 (0.19) [-0.01]	-0.66[c] (0.37) [-0.05]	18.84[a] (5.86) [0.16]	3.02 (5.10) [0.03]	-0.64 (4.43) [-0.01]	-8.70 (6.84) [-0.08]	-77.01 (--) [--]	R^2=0.30 F(14,320) =9.6
5.	Complete blood count	0.24 (0.49) [0.04]	1.12[b] (0.56) [0.17]	1.66[a] (0.77) [0.25]	0.25 (0.42) [0.04]	-0.62 (0.84) [-0.09]	0.00041 (0.00032) [0.30]	-0.040[c] (0.021) [-0.13]	-- (--) [--]	-0.54 (0.40) [-0.33]	-0.0033 (0.0039) [-0.01]	-0.095[a] (0.030) [-0.12]	0.21 (0.40) [0.03]	-0.32 (0.39) [-0.05]	-0.33 (0.39) [-0.05]	-0.44 (0.60) [0.07]	9.69 (--) [--]	R^2=0.19 F(14,323) =5.4
6.	Electro-cardiogram	-0.24 (0.68) [-0.01]	2.30[a] (0.66) [0.13]	-1.59 (1.07) [-0.09]	0.19 (0.48) [0.01]	2.82[a] (1.00) [0.16]	0.00086[b] (0.00043) [0.24]	-- (--) [--]	-0.064 (0.065) [-0.01]	-1.46[a] (0.66) [-0.34]	-0.0064 (0.021) [-0.01]	-0.015 (0.039) [-0.01]	1.76[a] (0.50) [0.10]	0.56 (0.50) [0.03]	-1.01[b] (0.50) [-0.06]	-1.77[a] (0.68) [-0.10]	15.03 (--) [--]	R^2=0.27 F(14,435) =11.5

Notes: a. Statistically significant at the 1 percent level.

b. Statistically significant at the 5 percent level.

c. Statistically significant at the 10 percent level.

excluded control variable. BD51 is statistically significant at the five percent level or better in four of the six payment regressions; in a fifth, the parameter estimate is substantially greater than its standard error. Only in the hernia repair regression is the BD51 coefficient both small and very imprecise. It is noteworthy that even in this case, the simple correlation between BD51 and the hernia payment is highest of all the explanatory variables (+0.22). The insignificant impact is attributable to multicollinearity in a regression based on comparatively few physicians.

Judging from the numbers in brackets, medical society appointment of 50 percent or more of the Blue Shield board raises payment levels relative to the "none apparent" groups of plans on average by 15 and 28 percent for the two visit variables, 17 and 13 percent for the two medical-laboratory variables, and by 4 and 9 percent, respectively, for the two surgical procedure variables. These patterns suggest that surgical specialists may be getting "the short end of the stick" in physician-controlled plans. But far more evidence is needed, for example, on the specialty composition of physicians on boards before a firm conclusion is warranted on this matter. The pattern does serve to emphasize, however, that all types of physicians may not benefit equally even if, as a group, they have an important, or even dominant, role in plan decisionmaking.

As anticipated, impacts of BD49 plans, relative to the "none apparent" reference group, tend to be smaller. Payments for visits are 12 percent higher on average. Those for the complete blood count and electrocardiogram are essentially the same as the "none apparent" group.

A self-perpetuating board may or may not be subject to medical society influence. "Self-perpetuating" amounts to "more of the same." The signs on BDSP vary; it is best to conclude that on average, payments are about the same as for the reference group, holding all the other factors in the regression constant. As seen in Table 7-1, only 9 percent of the physicians in the national-regional sample fall into the BDSP category, far fewer than those in BD51 (54 percent). Hence, any public policy specifically addressed to the BDSP plans would have a smaller potential effect in any event.

With one exception, control of all committees (COM) has a positive impact in five of the six regressions; the coefficient is statistically significant in 3 out or 6 regressions. In one instance, followup office visits, the estimated effect on payments is substantial, 31 percent. It is noteworthy that COM represents a rather independent dimension of physician control; simple correlations with BD49 and BD51 tend to be quite small.

As noted above, the vast majority of Blue Shield plans have formal medical society approval. Simple correlations indicate that MSOC is positively related to BD51 and negatively related to BD49. In general, the MSOC coefficients imply that payment levels are higher in plans with medical society approval, but there are two exceptions (diagnostic D and C and complete blood count).

The payment regressions include three variables representing exogenous influences on the demand for complete insurance coverage--per capita income and measures of importance of unionization and agricultural employment. As mentioned earlier, several other demand variables were included in preliminary regressions, but none of these had a statistically significant impact on payment levels. Of the three present in Table 7-2's regressions, only per capita income (Y) demonstrates a consistently meaningful impact on Blue Shield payments. Not only is the Y parameter estimate statistically significant in five out of six regressions, but the associated elasticities, ranging from 0.24 to 0.57, are substantial. Results on the unionization and agricultural percentages are disappointing, especially in view of past research on demand for insurance.

Three variables in addition to Y represent exogenous factors accounting for shifts in the physician supply curve. In four of the six regressions, the wage variable (W) has a positive impact on payment levels, and the W coefficient is statistically significant in three of the four. In all three instances, associated W elasticities are substantial, ranging from 0.28 for hospital visit to 0.92 for diagnostic D and C reimbursements. The high W elasticities for the followup office visit and diagnostic D and C are understandable since these procedures are aide-intensive. But the complete blood count also relies extensively on aides, and the -0.33 estimated elasticity for this procedure is surprising. Parameter estimates on CFMG are uniformly negative and often statistically significant. Although generally negative, the CAGE coefficients are positive in two cases.

Finally, the positive signs on SPEC imply that Blue Shield plans generally recognize specialty for reimbursement purposes. In preliminary regressions, a variable representing the percentage of specialists in the physician's PSU showed insignificant impacts on reimbursements, probably because of its correlation with the CAGE. With one exception, board certified physicians are paid more. In a descriptive analysis of Medicare payment levels, Muller and Otelsberg (1979) found the same anomalous result, i.e., general practitioners recieve higher payments for a complete blood count. A variable identifying physicians with clinical medical school appointments was dropped from the payment regressions after showing no impact on Blue Shield payment levels. As expected, older and foreign trained physicians are paid less, holding other factors constant.

Participation Regressions

Table 7-3 presents reduced form participation regressions. Since the dependent variable is binary (=1 for participating physicians), probit is an appropriate estimator. The first regression uses the entire national-regional sample; the second, which includes four physician characteristics variables unavailable from the regional survey, is based on the national survey. With probit, even a linear functional form generates non-linear first derivatives. For this reason, approximate marginal effects, evaluated at the observational means, are presented in Table 7-3 for the binary explanatory variables; associated elasticities are shown for their continuous counterparts.

As above, primary interest centers on the Blue Shield plan variables. Given a positively-sloped supply curve, if physician control results in higher Blue Shield payments, physicians should be more willing to accept Blue Shield payment as payment-in-full. As seen in Table 7-3, physicians practicing in areas where medical societies make appointments to Blue Shield boards are more likely to participate. The positive and statistically significant coefficients on BD49 and BD51 are consistent with the results on Blue Shield payments; however, the fact that the estimated marginal impacts for BD49 are higher is somewhat surprising since the BD51 variable tends to have a stronger impact on payment levels. In the national-regional regression, for example, the probability that a doctor in a BD49 plan area participates is 0.20 higher than if there

Table 7-5 Participation Regressions

Explanatory Variables	Regressions		Estimated Impacts			
	(1) National-Regional Sample	(2) National Sample	Marginal Effect from Regression 1	Elasticity from Regression 1	Marginal Effect from Regression 2	Elasticity from Regression 2
BD49	0.83^{a} (0.14)	0.89^{a} (0.20)	0.20	--	0.14	--
BD51	0.53^{a} (0.13)	0.38^{b} (0.18)	0.14	--	0.08	--
BDSP	1.36^{a} (0.25)	1.62^{a} (0.39)	0.31	--	0.16	--
COM	-0.48^{a} (0.10)	-0.49^{a} (0.14)	-0.08	--	-0.06	--
MSOC	0.087^{a} (0.027)	0.070^{c} (0.039)	0.02	--	0.01	--
Y	-0.00030^{a} (0.00009)	-0.00047^{a} (0.00012)	--	-0.27	--	-0.30
W	-0.27^{c} (0.14)	-0.41^{b} (0.20)	--	-0.22	--	-0.19
CAGE	0.018^{a} (0.004)	0.014^{b} (0.006)	--	0.10	--	0.08
CFMG	-0.018^{b} (0.009)	-0.024^{b} (0.012)	--	0.04	--	0.03
SPEC	0.054 (0.113)	0.12 (0.15)	0.01	--	0.02	--
BCERT	-0.099 (0.11)	-0.12 (0.14)	-0.02	--	-0.02	--
FAC	-0.33^{b} (0.14)	-0.51^{a} (0.20)	-0.07	--	-0.10	--
AGE	0.15 (0.11)	0.39^{a} (0.15)	0.03	--	0.05	--
FMG	0.16 (0.16)	0.41^{c} (0.21)	0.03	--	0.05	--
CH	-- (--)	0.18 (0.19)	--	--	0.02	--
MAR	-- (--)	0.006 (0.21)	--	--	--	0.00
PY	-- (--)	-0.25 (0.16)	--	--	-0.04	--
HL	-- (--)	-0.021 (0.17)	--	--	0.00	--
Constant	2.60^{a} (0.76)	4.27^{a} (1.15)	--	--	--	--
Observations	1199	718				

Notes: a. Statistically significant at the 1 percent level.
b. Statistically significant at the 5 percent level.
c. Statistically significant at the 10 percent level.

is no apparent role for the medical society in Blue Shield board appointments. The difference between BD51 and "none apparent" is only 0.14. This pattern is not easily explained. It is noteworthy that this result is insensitive to alternative specifications and estimators (OLS, not shown, versus probit). Although this pattern is unexpected, conflicting relative impacts does not detract from the overall conclusion that both payment levels and participation are higher when physicians' organizations have some control over board appointments.

The participation results on BDSP and COM, however, seem to involve more important contradictions vis-à-vis those on payments. Physicians located in plan areas where the board is self-perpetuating are more likely to participate than physicians in areas in which medical societies appoint the boards. Yet, in the previous table, half of the BDSP coefficients were negative. Some of the variability in the BDSP payment coefficients may be due to inadequate sample size. For example, the largest positive and negative BDSP estimated effects in Table 7-2, for complete blood count and hernia repairs, respectively, are based on samples of 28 and 34 observations. The hospital and office visit estimates in Table 7-2 and the national-regional BDSP parameter estimates in Table 7-3 are all based on samples of BDSP physicians over three times as large. It is best to await larger samples before making much of results on self-perpetuating boards. Although now comparatively rare, if Blue Shield plans change to self-perpetuating from medical society appointed boards as a result of antitrust pressures, these arrangements would merit a closer look.

In Table 7-2, the COM coefficients were positive with one important exception (hospital visits) although the estimated impacts tended to be lower than for BD51. The negative sign on the COM coefficients in Table 7-3 and the implied small, negative marginal effects suggest either that (1) physician control of Blue Shield committees is not an adequate measure of overall physician control, (2) the relevant influence is inadequately measured, e.g., control of a few committees rather than of all 5 may be key, or (3) overall physician control does not affect payments and participation in a way predicted by the analytic framework. Given the results on other Blue Shield plan variables, the third explanation is by far the least likely one.

The MSOC coefficients imply that plans with formal medical society approval have 1 to 2 percent higher participation rates on average. This is consistent with estimated impacts of MSOC on payments.

As in past research on physician participation in Blue Shield and Medicaid plans, higher per capita income deters participation, and the associated elasticity is substantial.[31] The positive Y coefficients in Table 7-2 reflect both a higher demand for complete insurance coverage and an inward supply curve shift because physicians can command higher fees from non-service benefit patients in high per capita income areas. The negative impacts of Y on participation in Table 7-3 suggest that the latter supply shift effect has a dominant influence on participation.

As seen in Table 7-2, higher wages of non-physician personnel are not always reflected in higher Blue Shield payments, and, even when W has a positive effect, the associated elasticity is far less than one. Thus, the negative implied effects of W on participation in Table 7-3 comes as no surprise.

The remaining estimated marginal impacts and elasticities in Table 7-3 are quite small. The largest effect of these variables corresponds to physicians with faculty affiliations (FAC). The analysis of payment levels indicates that Blue Shield generally does not reward faculty affiliation, perhaps because it is costly for the plans to take more than a few "objective" characteristics into account for reimbursement purposes.

FURTHER DISCUSSION AND CONCLUSIONS

As of the mid-1970s, boards of the majority of Blue Shield plans were selected by medical societies. As a rule, medical society control over board appointments has led to the selection of physician-dominated boards. In fact, the relationship between board selection method and the proportion of physicians on boards proved to be so close that precise estimates could not be obtained when both selection method and occupational mix of board variables were included, and, for this reason, the physician proportion on Blue Shield boards was eliminated from the regressions.

With greater medical society involvement in board selection, Blue Shield payments for specific types of services tend to rise. Consistent with this finding, physician participation in Blue Shield service benefit programs rises when medical societies control board appointments.

From the vantage point of cost containment, physician control not only raises procedure-specific reimbursements, but it is likely both to increase physicians' fees overall and reduce physician willingness to accept Medicaid and Medicare payments as payment-in-full. Sloan, Cromwell, and Mitchell (1978a, 1978b), using the same data base as in this study, found that higher Blue Shield fee schedules discourage physician involvement with Medicaid. Associated elasticities in the -0.3 to -0.5 range indicate that this "discouragement effect" is far more than trivial.

More generous Blue Shield payments in effect bid physicians' services away from other groups. Thus, although a policy aimed at reducing physician control over Blue Shield plans would reduce the access of its enrollees to physicians, it would probably have the opposite impact on persons covered by other third party payment programs. Thus, the "trust-buster" is not necessarily faced with the typical cost-patient access tradeoff. Severing ties between organized medicine and Blue Shield plans may well result in improvement on both counts.

To date, no empirical study has established a link between Blue Shield reimbursement levels and physicians' fees. Using a standard model of firm behavior, the potential impact of reimbursement on fees is unambiguous. To the extent that the impact is shown to be important, and given Blue Shield's typical market share this is likely, the implications of control are even more far reaching.

Without denying the overall merit of severing ties between Blue Shield plans and organized medicine, a balanced view requires consideration of the following additional points. First, though positive and consequential, the estimated impacts of control variables on Blue Shield payment levels are by no means huge. Actions to eliminate physician control, though contributory to cost control, should not be viewed as a panacea. Second, the single cross-section available for this study only permits us to assess payment levels. The data do not allow one to make inferences about differential rates of change in payments.

Third, some anomalous findings reported above suggest that there is more to be learned about the rather intricate interrelationships between physicians and Blue Shield plans. It is clear that physicians must provide third party payors with expertise, but as technical consultants rather than as decisionmakers. Physician presence on various Blue Shield reimbursement committees should not be questioned. Considering all the evidence, one should conclude from this study that physician control of committees (as contrasted with board control) does not generally lead to higher Blue Shield payments and higher rates of physician participation (although, in general, Blue Shield payments are higher when committees are controlled).

There is more to be learned about how these committees function, and under what circumstances, if any, physician domination of committees yields undesirable outcomes.

Fourth, this analysis has only investigated one aspect, albeit an important one, of physician control. Other potential consequences of control, such as the effect on reimbursement of non-physician practitioners, should be assessed.

FOOTNOTES TO CHAPTER 7

[1] Scherer (1970), Kahn (1970), and Posner (1976).

[2] Health Insurance Institute (1978-79).

[3] Health Insurance Institute (1978-79). The estimate of market share is based on benefit payments data.

[4] See Frech and Ginsburg (1978) and Berman's (1978) reply.

[5] See Federal Trade Commission (1979), pp. 1-2 for documentation.

[6] Unpublished Blue Shield brochure. Emphasis is Blue Shield's.

[7] Goldberg and Greenberg (1978) describe the origins of the Oregon Physicians' Service, the forerunner of Blue Shield in Oregon, a pre-payment plan organized by physicians as a means of (successfully) driving out other insurers from that state. Also, see Reed (1947), Kessel (1958), Federal Trade Commission (1979), and Thompson (1979).

[8] A more detailed description of the service benefit concept is presented by Sloan and Steinwald (1975, 1978).

[9] Sloan and Steinwald (1978). Their data are for 1973.

[10] See, for example, American Medical News (1977), Anderson (1975), Enright (1978), Rosencrans (1979), and Sheridan (1977).

[11] This list reflects empirical research on health insurance by Feldstein (1973); Phelps (1973, 1976), Sloan and Steinwald (1980), and others.

[12] See, for example, Cohen and Cyert (1975), Kreps, Somers, and Perlman (1974), and Malinvaud (1972).

[13] Equation (7-9) can be rewritten as $g_x x + g(\cdot) = \frac{\lambda}{1-\lambda} p_r q_x e$. Thus, for (7-9) to hold, $\frac{\lambda}{1-\lambda} \geq 0$. This only occurs for $0 \leq \lambda < 1$.

[14] The comparative statics are readily derived. For comparative statics on the producer cooperative model, see Domar (1966).

[15] In 1977 medical societies appointed the majority of board members in 48 percent of the 27 plans; the corresponding percentage for the universe was 61. In the sample of 27, physicians had a supervisory function over all of 5 major committees in 63 percent of plans; the corresponding percentage for all plans was 75 in 1977. See the text below for further details.

[16] A continuous measure of x would have been more desirable, but it is not available from any data base (for which total practice output is also available). The binary variable certainly correlated with its continuous "cousin" since, for non-participants, x=0.

[17] Payments for a simple suture are also available from the survey; but this procedure was eliminated from our analysis because NORC reported that physicians found the suture question ambiguous.

[18] Described in Institute of Medicine (1976).

[19] To my knowledge, physicians participate on a case-by-case basis in two states, but some physicians from other states also gave this response. These physicians probably mean that they participate in "partial service benefit" programs. For a description of this arrangement see Sloan and Steinwald (1978). Unlike the Sloan-Steinwald study, which only includes physicians who made an individual participation decision, the participation dependent variable used here encompasses individual physician and collective medical society participation decisions.

[20] See Federal Trade Commission (1979). Data for BD49, BD51, and BDSP come from this source and pertain to 1978. A few recent changes in appointment practices are noted in the FTC source. These changes tend to be minor, e.g., a change from BDSP to "none apparent." Nevertheless, I have taken these changes into account in defining the variables. In most instances, the plan bylays information abstracted by the FTC is for a year prior to 1978 (1970-1977) and still in effect in 1978.

[21] Medical societies appointed a majority of board members in more than 11 plans, but only in 11 out of my sample of 27.

[22] Sloan and Steinwald (1975) describe the UCR system. See also Chapter 3.

[23] Data are for 1977; source is U.S. House of Representatives (1978).

[24] Source is U.S. House of Representatives (1978). Another variable one might include is the Blue Shield market share. I have excluded this variable from reduced form equations on grounds that the share is likely to be a result of (rather than a reason for) physician control. The market share was included as an explanatory variable in preliminary regressions; results on the control variables tend to be insensitive to its inclusion or exclusion.

[25] The variable Y, deflated by an area cost-of-living index, is defined for the physician's county; data are from the 1974 Current Population Survey. AGR, also defined for the county, comes from the 1970 U.S. Census of Population. Data for UNION, unfortunately only available by state, come from U.S. Department of Commerce (1977).

[26] This is what Sloan and Steinwald (1978) found.

[27] An exception is made for graduates of Mexican medical schools, who for purposes of this study are considered domestic graduates.

[28] CAGE and CFMG are based on distributions of respondents to the NORC survey.

[29] Justifications for including these variables is presented in Sloan, Cromwell, and Mitchell (1978).

[30] The principal reason for the loss of observations is missing values on the payment dependent variables. In many cases, the physician did not perform the procedure in question. In others, he or his aides were uncertain about the amounts particular third parties paid.

[31] See Sloan and Steinwald (1978) and Sloan, Cromwell, and Mitchell (1978a, 1978b).

Chapter 8

State Discretion in Federal Categorical Assistance Programs: Analysis of Variations in Medicaid Payments for Physicians' Services

Frank A. Sloan

INTRODUCTION

One of the dominant features of the U.S. system of government is the latitude given states and localities under many federal programs to decide both administrative procedures and practices and thereby the amount of the federal transfer to states and localities. Historically, this approach has been used extensively in the area of public assistance with the result that federal transfers to states and localities per taxpayer, criteria for welfare eligibility, and assistance payments per beneficiary vary widely. In recent years, widespread recognition of these disparities has led to political pressures to federalize the entire welfare program.

With expenditures growing at a compound rate of 15.2 percent per annum,[1] many states would like to rid themselves of their Medicaid programs and, in the main, would support federalizaion. In addition, persons concerned with equity issues find fault with the fact that similarly-situated taxpayers and beneficiaries pay or receive different amounts, depending on their state (Stuart, 1972).

Yet, although federalization has advantages, it also has potential deficiencies. First, the rationale for multi-level finance is to allow program effort to reflect, at least in part, geographic variations in preferences for particular publically-supplied goods. Second, even without direct state-local government input, there is considerable geographic variation in some federal programs. For example, observed variations in Medicare reimbursements reflect interactions of beneficiaries, providers, and discretionary practices of Medicare carriers who process claims for payment.[2] Further, Medicare outlays also rose dramatically during the 1970s. Behavior of governmental authorities in implementing legislation (e.g., regulation-writing), bureaucratic processes in everyday administration, and responses of the public at large tend to be exceedingly complex. Certainly federalization *per se* is not a panacea.

This study examines one aspect of one major public assistance program, namely why Medicaid payments to physicians for performing specific procedures vary. Even though payments to physicians constitute only 9 to 10 percent of total Medicaid outlays,[3] physicians' decisions determine referral and use patterns throughout the health care system. Moreover, involvement of office-based physicians is key to the program's success. Medicaid was enacted in the mid-1960s with the intent of improving access of low-income persons to "mainstream" medicine. When office-based physicians are unwilling to accept Medicaid patients, the latter must rely on "free" clinics, both hospital and nonhospital, for entry into the health care system. Continuity of care is often lacking at the latter types of locations, and patients, especially those with low levels of schooling, are more likely to be "pushed" around the system.[4]

There is now quite conclusive evidence that office-based physician willingness to treat Medicaid patients is contingent on both Medicaid payment levels and bureaucratic hassles necessary for obtaining payment,[5] but past research leaves unanswered how and why payment levels and hassles vary and how desired changes in these two dimensions of Medicaid may best be implemented.

Two conceptual approaches are followed in this study. The first treats income redistribution and in-kind public assistance payments as a public good. This standard "economic" model specifies a utility function for a representative taxpayer with the median voter's preference. The constraint requires that Medicaid payments to doctors be financed by the sum of state tax payments and federal subsidies. Comparative statics analysis allows one to assess the effects of changes in federal subsidy policy, the number of indigents and taxpayers, preferences of voters in the state, and exogenous factors associated with shifts in the curve relating the quantity of service physicians are willing to supply Medicaid patients to procedure-specific payments on the amount the state Medicaid program pays physicians for specific procedures.

Another view, not mutually exclusive with the first, is that Medicaid payments are largely determined by interactions between government bureaucracies, private insurance carriers serving as fiscal agents for Medicaid, and physicians, both individually and collectively. According to this latter view, for long time periods, Medicaid programs run on their "own steam," not policed by the taxpaying public or their representatives in the legislative or executive branches. Hence, Medicaid payment levels at any given time could be far from those desired by the taxpaying public. This latter explanation of Medicaid reimbursement patterns implies that structural characteristics of the state program, such as where the Medicaid program is housed and the type of reimbursement methods used, should be central to the analysis.

The next section presents some pertinent background information on Medicaid. Discussions of the analytic framework, empirical specification, and empirical results follow. The last section summarizes the study and develops policy implications.

BACKGROUND

Medicaid, Title XIX of the Social Security Act, became federal law in 1965. For high income states, the law specifies 50 percent federal matching for a wide variety of covered health care expenditures; less affluent states are subject to federal matching up to 83 percent. The matching formula, the Federal Medical Assistance Percentage (FMAP), is based on per capita income in a previous three year period and is updated every two years. The matching rate, for example, for 1976 was calculated on the basis of 1971-73 per capita income.[6] As of the mid-1970s, 10 out of the 47 states with Medicaid programs had FMAPs of 50 percent; the highest FMAP was 78 percent (for Mississippi).[7]

By statute, Medicaid operates as a vendor program. Payments for services rendered are made directly to providers who must accept the Medicaid reimbursement level as payment-in-full. Providers are free to refuse to treat Medicaid patients, and many office-based physicians opt out of the program.[8] Copayments may be required of beneficiaries, but are uncommon.[9]

With a few noteworthy exceptions, states have considerable latitude in designing their Medicaid programs.[10] They have an important role in defining the recipient population, determining services provided, establishing methods and levels of payment,[11] benefit ceilings, copayment requirements, and determining the agencies that administer the state program.

For purposes of this study, two program dimensions determined at the state level are particularly pertinent. First, states are free to select the methods used to determine reimbursement levels for services rendered by physicians so long as the method of reimbursement determination is related to the cost of care in some reasonable way and the fee so established does not exceed the fee set for the same procedure under Medicare. Therefore, the Medicare fee effectively sets the upper bound for physician reimubrsement under Medicaid. If they so desire, states may simply adopt the Medicare fee schedule as their Medicaid schedule as well.

Medicare determines physician payment levels, using a "usual, customary, and reasonable" (UCR) method, but is certainly not the only insurer to use it.[12] Under UCR, historical profiles of fees are established for individual physicians (usual fees) and for similar physicians in a community (customary fees). A claim for a covered service is reimbursed in full if (1) the fee does not exceed the physician's typical (presumably, modal) charge for the procedure and (2) if the fee is less than or equal to a fee corresponding to a specified percentile level in the community's frequency distribution of physician's fees for the procedure (the 75 percentile for Medicare). If a physician's claim exceeds the usual and/or customary fee, it may still be paid in full if the physician can demonstrate extenuating circumstances to explain the high fee, the reasonable criterion.

Whether UCR results in higher reimbursements than a system of fixed fee schedules depends on administrative practices of the insurer. The insurer can impede the growth of payments by (1) making it more difficult for the physician to update his usual charge, (2) reducing the percentile cutoff in the community fee distribution the insurer uses to determine the customary fee, and/or (3) using data from an earlier period to represent the current fee distribution in the area. There is some empirical evidence from the 1960s that UCR results in higher reimbursements for physicians' services than fixed fee schedules (Sloan and Steinwald, 1975), but it is entirely possible that private and public third party payors using UCR have learned from their mistakes of the 1960s, when reimbursements often exceeded third parties' expectations.[13]

Given the lack of "hard" evidence to the contrary, it is assumed here as a working hypothesis that Medicaid procedure-specific payments are highest when the Medicare reimbursement method is used, followed by a UCR-type reimbursement procedure using standards other than Medicare, and fixed fee schedules in descending order. Among the three, the second method is the most popular. States reimbursing on the basis of Medicare and fixed fee schedules are quite varied. For example, as of the mid-1970s, the fixed fee schedule states were California, Maryland, Massachusetts, Mississippi, New York, Oregon, and West Virginia.[14] Medicare method states were geographically dispersed, but, on average, had high proportions of rural residents.

Another potentially important structural dimension is the type of state agency administering the Medicaid program. Agencies may differ in objectives as well as in constituencies. For example, hospitals and other licensed health care institutions are typically the constituency of a state health agency (Kissam, 1975). Hence, such agencies may be less subject to political pressures from private physicians. Four types of state agencies administer Medicaid programs: health departments; welfare departments; "umbrella" agencies responsible for both health and welfare functions, e.g., a Department of Human Resources or Department of Health and Rehabilitative Services; special agencies or commissions established in a state for the specific purpose of administering Medicaid. Among the four types, umbrella and welfare agencies have been selected to administer Medicaid most frequently.[15]

ANALYTIC FRAMEWORK

Assume a representative voter-taxpayer has the following utility function (U)

(8-1) $U = U(\pi, \frac{X}{p}; M)$, where

π = disposable income of the representative voter-taxpayer;
X = total quantity of Medicaid services provided by physicians in the state;
p = number of persons in "poverty" in the state;
M = any exogenous variable affecting the taxpayer's preferences for private goods versus Medicaid services for the poor.

According to (8-1), taxpayer utility rises with the "standard of care" provided poor persons.[16] Taxpayer, not recipient, utility is considered by this model.

Disposable income (π) equals the taxpayer's pretax income (Y) minus his share of the total tax burden for the state.

(8-2) $\pi = Y - \frac{T}{n}$, where

T = total tax burden;
n = number of taxpayers in the state.

The quantities of service physicians in the state are willing to supply to Medicaid patients is given by

(8-3) $X = h(S;N)$, where

S = Medicaid payment per unit of service;
N = any exogenous variable shifting the physician supply curve facing the state Medicaid agency.

The state, and hence also the taxpayer, is not allowed to spend more on current account than it receives from the federal government in the form of intergovernmental transfers and from state (or state-local) taxes. The federal transfer F depends on Medicaid spending (B)

(8-4) $B = h(\cdot)S$ and

(8-5) $F(B) + T = h(\cdot)S$.

Let k be the FMAP, the federal share of total Medicaid outlays in the state. Then (8-5) becomes

(8-5)' $T = (1 - k)h(\cdot)S$

Substituting (8-5)' and (8-2) into (8-1),

(8-1)' $U = U(Y - \frac{(1 - k)}{n}h(\cdot)S, \frac{h(\cdot)}{p};M)$

Differentiating (1)' with respect to S, the first order condition is obtained:

(8-6) $U_S = U_\pi\left[-\left(\frac{(1 - k)}{n}\right)\left(h_S S + h(\cdot)\right)\right] + \frac{1}{p}U_h h_S = 0$

According to equation (8-6), at the optimum S for the utility maximizing taxpayer, the marginal utility of Medicaid services per poverty person equals the marginal disutility of forgone private goods.

Comparative statics analysis yields predictions of the effects of changes in exogenous variables on S. Table 8-1 presents a concise summary of comparative statics results. From the second order conditions for a maximum, U_{SS} is negative. Diminishing marginal utility of private goods and Medicaid services per poverty person is assumed. Signs on cross-partial derivatives in Table 8-1 reflect plausible functional forms.

Increases in the proportion of total Medicaid expense reimbursed by the federal government and in the number of taxpayers in the state (n) both are predicted to raise S.[17] As n increases, the cost of a given level of Medicaid benefits is spread over a larger number of taxpayers, in effect a reduction in the price of Medicaid services to the nonpoor taxpayer. Hence, a rise in the number of poor persons in the state is predicted to decrease the Medicaid payment per unit of service.

As the number of potential recipients rises, the cost of boosting the standard of service to (all) the poor rises, thereby encouraging the nonpoor to favor private goods. For this reason and because voters in wealthier states are more likely to purchase higher levels of medical care for their poor, Congress devised a formula awarding poorer states a higher federal subsidy.

The role of exogenous shifts in the physician supply function facing the Medicaid programs is more subtle. Essentially two types of variables are included in the "N" set of exogenous variables. The first kind, such as wages of non-physician personnel, affects the

Table 8-1. Predicted Effects of Changes in Exogenous Variables

Exogenous Change	Relevant Expression*	Predicted Effect on Medicaid Payment per Uni
Increase in taxpayer's pretax income	$\frac{dS}{dY} = -\frac{\overset{-}{U_{\pi\pi}}\overset{+}{\pi_Y}\overset{-}{[-A]} + \frac{1}{p}\overset{+}{U_{h\pi}}\overset{+}{[A]}\overset{+}{h_S} + \frac{1}{p}\overset{+}{U_{hY}}h_S}{U_{SS}}$	Positive**
Increase in number of poor persons	$\frac{dS}{dp} = -\frac{-\frac{1}{p^2}\overset{+}{U_h}\overset{+}{h_S}}{U_{SS}}$	Negativ
Increase in number of taxpayers	$\frac{dS}{dn} = -\frac{\overset{-}{U_{\pi\pi}}\{\overset{+}{\frac{(1-k)}{n^2}[h(\cdot)S]}\}\overset{-}{[-A]} + \overset{+}{U_\pi}\{\frac{(1-k)}{n^2}(\overset{+}{h_S}S + h)\}}{U_{SS}}$	Positiv
Increase in federal Medicaid percentage (FMAP)	$\frac{dS}{dk} = -\frac{\overset{-}{U_{\pi\pi}}\{\frac{1}{n}\overset{+}{h(\cdot)}S\}\overset{-}{[-A]} + \overset{+}{U_\pi}\{\frac{1}{n}(\overset{+}{h_S}S + h)\}}{U_{SS}}$	Positiv
"Better" physician credentials, decrease in physician-population ratio, increase in wage-rates of ancillary personnel	$\frac{dS}{dN} = -\frac{\overset{-}{U_{\pi\pi}}\{-\overset{+}{\frac{(1-k)}{n}}h_N S\}\overset{-}{[-A]} + \overset{+}{U_\pi}\{-\frac{(1-k)}{n}(\overset{+}{h_{SN}S} + h_N)\}}{U_{SS}}$	
	$-\frac{\frac{1}{p}\{U_{hh}\overset{+}{h_N}h_S + U_h\overset{-\text{ or }0}{h_{SN}}\}}{U_{SS}}$	Ambiguous

---

*$A = \frac{1-k}{n}(h_S S + h(\cdot))$. Pluses and minuses above terms indicate plausible directions of effect.

**See comment in text on this exogenous change.

physician's cost function and hence the asking price of services to any group of patients. A second reflects physicians' opportunities in markets for non-Medicaid patients. Presumably physicians with more prestigious credentials can charge higher prices to non-Medicaid patients and, for this reason, are less willing to treat Medicaid recipients, given that Medicaid is a far less generous program to physicians.

Using comparative statics analysis on a model of the physician firm, Sloan, _et al_. (1978a) argued that physicians practicing in areas with low physician-population ratios and where patients have high per capita incomes should be less willing to participate. The second result was supported empirically, but not the first. Nevertheless, the theoretical result on physician availability from the Sloan, _et al_. study is accepted here as a working, albeit tentative, hypothesis.

Table 8-1 evaluates effects on S of an inward shift of the physician supply curve facing the state Medicaid program. All but the final term of the expression for $\frac{dS}{dN}$ indicate that the expected effect of the inward shift of S is positive. The last term contains a zero or negative cross-partial h_{SN}, reflecting changes in the slope of the supply curve with changes in N. Thus, the inward supply shift raises S _if_ h_{SN} is comparatively small in absolute value.

Table 8-1 does not reflect the notion that patients' pretax income may be an element of N. With S as the dependent variable, it is impossible to discern whether S is high because in-kind payments to the poor are a normal good or because of physician supply function shifts attributable to Y.

To better isolate the roles of selected variables, such as Y, on Medicaid program generosity as opposed to their effects on the physicians' services market, sets of regressions with S and, alternatively, with S as a percentage of the physician's usual fee ($\tilde{S}$), as dependent variables are estimated. Comparative statics, using either dependent variable, are identical with one important exception. In the second specification, the physician's usual fee is exogenous, and the decision for the Medicaid program involves the percentage of this fee it pays. The N factors affect $\tilde{S}$ and thus should be eliminated in the latter specification.

The above voter-taxpayer model differs substantially from the view that Medicaid decisions principally reflect actions and reactions of government bureaucrats and their agents. Rather than specify a formal model of bureaucratic decisionmaking, a set of explanatory variables reflecting structural differences in state Medicaid programs is included as a final step in our regressions.

DATA AND REGRESSION SPECIFICATION

Data

Data on Medicaid payment levels and physicians' usual fees come from the same HCFA-NORC survey of 2,024 private-practice fee-for-service physicians as the survey on which the analysis in Chapter 7 is based. As described in Chapter 7, the data pertain to 1975 and 1976 and are restricted to physicians in the largest fields: general-family practice, general surgery, internal medicine, obstetrics-gynecology, and pediatrics. Items covered pertain to practice inputs, outputs, prices, costs, and third-party reimbursement--including third-party payment levels for various procedures and administrative burdens imposed on physicians by different types of insurers.

General surgeons, obstetricians-gynecologists, and pediatricians are slightly overrepresented in the sample because of higher response rates with corresponding underrepresentation among general practitioners and internists. Foreign medical school graduates, board-certified, and older physicians were somewhat more willing to respond. Physicians practicing in groups with 15 or more members were excluded because it was apparent in advance that the cost of obtaining data rises markedly with group size.[18] A total of 25 of the 47 states in the coterminous U.S. with a Medicaid program are included in the combined national-regional sample; the included states are larger than average, accounting for 78 percent of the U.S. population. States in the Mountain and West North Central Census Divisions are somewhat underrepresented.

The sample sizes noted below for any particular regression tend to be considerably smaller than the above for two principal reasons. First, it is inappropriate to infer the total number of degrees of freedom by simply adding the numbers of observations in each sample. Combining both national and regional samples, NORC estimates there are 1,672 effective degrees of freedom. Second, the fee questions were frequently not answered by the physician because a certain procedure (e.g., hernia repair) did not apply to his practice, he did not possess the requisite information, or in a few instances, he simply refused to answer.

Information from other sources had been merged with the NORC survey: biographical data on the physician from the American Medical Association; data on state Medicaid program characteristics and other attributes of the state in which the physician practices; and a wage index specified for the physician's PSU. All monetarily-expressed variables have been deflated by an area price index.[19]

All regressions use the individual physician as the observational unit. The sample size is inadequate to yield reliable estimates for areas. Moreover, as discussed above, many state Medicaid programs make distinctions among physicians for reimbursement purposes, a point not explicitly recognized by our analytic framework (but consistent with it). Identification of those individual professional characteristics recognized by Medicaid is worthwhile in its own right. Analysis of payments at the level of the individual physician permits this. There is substantial variation in procedure-specific payment levels within PSUs.[20]

Regression Specification

The HCFA-NORC surveys requested data on physicians' usual fees and amounts paid by various third parties, including Medicaid, for these procedures: followup hospital visit; followup office visit; inguinal hernia repair; diagnostic D and C; complete blood count; suture of a simple laceration; and electrocardiogram. Physician respondents found the suture question ambiguous. For this reason, no attempt is made here to analyze variations in Medicaid payments for this procedure. Dependent variables are measures of S and $(S/\tilde{S})$ for the other six procedures.

Explanatory variables fall into five categories: (1) "prices" of Medicaid to the voter-taxpayer--k, n, and p variables; (2) factors shifting the nonpoor's demand for in-kind transfers--Y and M variables; (3) supply shift variables--the N variables; (4) structural characteristics of the Medicaid program; and (5) individual physician characteristics. All variables in the first, second, and fourth categories and all except one in the third, a wage index W, are defined for the physician's state. All variables in the fifth pertain to the individual physician.

The roles of the price variables have been described above. In the empirical analysis, K represents the federal share of state Medicaid outlays (FMAP); p and n variables are expressed as the number of persons in poverty as a percentage of the number of nonpoor in the state, POVP.

Although the model specifies separate effects for p and n, multicollinearity precludes this; both (by definition) are closely related to state size. Based on the above model, POVP should have a negative impact on the level of Medicaid payments.

Real personal per capita income in the state represents Y. The M variables include the percentage of the vote for Nixon in 1972, RPUB, the percentage of the state living in metropolitan areas, MET, and the percentage of state population that is black, BLACK. The RPUB variable is a good measure of conservatism because (1) the Democratic candidate in that year was liberal ideologically, and (2) compared with other years, votes were not along traditional party lines. It is generally assumed that the white majority is less favorable to public assistance in states with high black populations; there is some empirical evidence for this.[21]

Supply shift variables include percentages of physicians who are female, FEM, foreign medical school graduates, FMG, and general practitioners, GP, active physicians per 1,000 state population, MD, and an index of wages of ancillary personnel in physicians' practices, W. The NORC survey collected wage data on all nonphysician employees in the practice. For coding purposes, nonphysician occupations were grouped into 10 occupational categories; indexes by PSU were constructed using the national distribution of the 10 categories as weights.

There are two types of measures of structural program characteristics. First, programs are classified according to whether they use a fee schedule FSCHD, reimburse on the same basis as Medicare, FT18, or use a UCR method but with screens different from the Medicaid program, the omitted reference category. A priori, it is reasonable to expect

Medicaid payments to be highest in FT18 states and lowest in FSCHD states. Second, states are distinguished on the basis of the kind of agency in which the Medicaid program is housed: health department, AHLTH; umbrella agency, AUBLA; special agency, ADSPEC; and welfare agency, the reference group. Finally, some variants contain the percentage of physicians in the state who are members of the American Medical Association, AMA, as a measure of the political power of organized medicine in the state.[22]

Individual physician characteristics consist of binary variables SPEC, BCERT, FAC, FMG, and AGE, which are one, respectively, if the physician is a specialist, is board-certified in a specialty, if he has a medical school appointment, if he is a graduate of a foreign medical school in a non-English-speaking, non-Western European country, and if the physician was age 60 or over at the time of the survey.[23]

Table 8-2 presents concise variable definitions, means, and standard deviations. As seen in the table, an "R" at the end of the dependent payment variable signifies that the Medicaid payment is expressed as a percentage of the physician's usual fee for the procedure. These percentages vary from 68.0 for followup hospital visits to 80.8 for complete blood counts.

EMPIRICAL RESULTS

Results of the regression analysis are presented in Table 8-3. The first column gives the regression number; in the second column, the regression's dependent variable is identified. When the dependent variable is the Medicaid payment level for a specific procedure, which applies to the first 6 regressions, R^2s range from 0.23 for followup hospital visits to 0.55 for diagnostic D and Cs. Structural program characteristics e 6-2 Concise Variable Definitions, Means, and Standard Deviations

able e	Definition	Mean*	Standard Deviation
	Medicaid payment for followup hospital visit ($)	8.36	3.14
	Ratio counterpart of FHV (%)	68.0	27.9
	Medicaid payment for followup office visit ($)	7.81	2.24
	Ratio counterpart of FOV (%)	74.3	23.5
	Medicaid payment for inguinal hernia repair ($)	192.84	66.73
	Ratio counterpart of HR (%)	68.2	25.7
	Medicaid payment for diagnostic D and C ($)	85.29	29.04
	Ratio counterpart of DC (%)	68.4	28.4
	Medicaid payment for complete blood count ($)	5.83	2.98
	Ratio counterpart of CBC (%)	80.8	31.1
	Medicaid payment for electorcardiogram ($)	14.54	4.30
	Ratio counterpart of EKG (%)	73.8	22.6
	Federal Medical Assistance Percentage	56.4	7.8
	Persons in poverty as percent of nonpoor persons	12.6	4.4
	Per capita income ($)	6149.	521.
	Percentage vote for Nixon in 1972	60.9	6.1
	Percentage living in metropolitan areas	73.3	21.7
CK	Percentage of population that is black	10.6	7.0
	Physician is a specialist (B)**	0.63	0.48
RT	Physician is board certified (B)	0.45	0.50
	Physician is member of medical school faculty (B)	0.10	0.30
	Physician trained in "third world" country (B)	0.10	0.30
	Physician is age 60 or over (B)	0.26	0.44
	Percentage of doctors in state who are general practitioners	17.1	4.3
	State physicians per 1,000 population	1.4	0.31
	Percentage of doctors in state who are foreign-trained	17.6	11.5
	Percentage of doctors in state who are female	8.0	2.1
	Wage index ($)	3.89	0.38
	Percentage of doctors in state who are AMA members	64.8	7.8
HD	Medicaid uses fee schedule (B)	0.31	0.47
B	Medicaid uses Medicare reimbursement method	0.07	0.25
TH	Medicaid housed in Health Department (B)	0.16	0.36
LA	Medicaid housed in umbrella agency (B)	0.22	0.41
EC	Medicaid housed in special agency (B)	0.04	0.19

timates of means and standard deviations of the explanatory variables come from a FHVR regres-on. These estimates are reasonably invariant with respect to the regression selected, but it necessary to select one for purposes of constructing this table.

=binary variable.

Table 8-3 Medicaid Payment Regre

Reg. No.	Dep. Var.	K	POVP	Y	RPUB
1	FHV̂	0.047 (0.054)	-0.057 (0.067)	0.00068[c] (0.00040)	-0.040 (0.054)
2	FOV	0.026 (0.036)	-0.018 (0.046)	0.00017 (0.00026)	-0.077[b] (0.037)
3	HR	2.67 (1.93)	3.35 (2.78)	0.032[b] (0.014)	-3.80[c] (1.95)
4	DC	1.64[b] (0.74)	-1.38 (1.08)	0.017[a] (0.006)	-2.81[a] (0.80)
5	CBC	-0.12 (0.09)	0.23[b] (0.10)	-0.00049 (0.00083)	0.069 (0.077)
6	EKG	0.14 (0.10)	-0.26[b] (0.12)	0.0038[a] (0.0007)	0.34[a] (0.09)
7	FHVR	2.63 (0.33)	-1.74[a] (0.45)	0.026[a] (0.003)	-0.48[c] (0.25)
8	FHVR	2.51[a] (0.34)	-0.59 (0.55)	0.028[a] (0.003)	-0.88[a] (0.29)
9	FOVR	2.17[a] (0.26)	-2.10[a] (0.37)	0.018[a] (0.002)	0.32[c] (0.19)
10	FOVR	2.04[a] (0.27)	-0.74[c] (0.44)	0.022[a] (0.002)	-0.27 (0.22)
11	HRR	3.36[a] (0.61)	-2.94[a] (0.81)	0.024[a] (0.004)	-0.61 (0.39)
12	HRR	3.63[a] (0.69)	-2.74[a] (0.95)	0.029[a] (0.005)	-0.78[c] (0.45)
13	DCR	3.25[a] (0.53)	-3.83[a] (0.71)	0.022[a] (0.004)	-0.52 (0.04)
14	CBCR	2.22[a] (0.62)	0.67 (0.79)	0.023[a] (0.005)	0.55 (0.50)
15	CBCR	2.16[a] (0.66)	1.69[c] (0.87)	0.035[a] (0.006)	0.040 (0.554)
16	EKGR	2.22[a] (0.37)	-1.39[a] (0.51)	0.020[a] (0.003)	0.068 (0.289)

Notes:
a. Statistically significant at the 1 percent level.
b. Statistically significant at the 5 percent level.
c. Statistically significant at the 10 percent level.

Table 8-3 Medicaid Payment Regressions

Reg. No.	Dep. Var.	K	POVP	Y	RPUB	MET	BLACK	SPEC	BCERT	FAC	FMG	AGE	GP	MD	SFMG	FEM	W	NMA	FSCHD	FT18	AHLTH	AUBLA	ASPEC	Constant	
1	FHV	0.047 (0.054)	-0.057 (0.067)	0.00068[c] (0.00040)	-0.040 (0.054)	0.016 (0.011)	-0.020 (0.034)	0.73[a] (0.27)	-0.12 (0.26)	0.12 (0.36)	-0.49 (0.36)	-0.61[b] (0.25)	0.048 (0.056)	-0.064 (0.12)	0.080[a] (0.024)	-0.68[a] (0.15)	1.60[a] (0.37)	-0.047 (0.031)	0.071 (0.555)	-0.24 (0.59)	1.82[a] (0.59)	1.31[a] (0.34)	1.09 (0.79)	3.12 (--)	R^2=0.23 F(22,763)=10.5
2	FOV	0.026 (0.036)	-0.018 (0.046)	0.00017 (0.00026)	-0.077[b] (0.037)	0.029[a] (0.008)	0.0073 (0.0224)	0.61[a] (0.18)	0.27 (0.17)	0.37 (0.25)	0.25 (0.24)	-0.093 (0.157)	-0.082[b] (0.038)	1.84[b] (0.74)	0.0033 (0.0163)	-0.70[a] (0.10)	0.62[b] (0.25)	0.044[b] (0.021)	0.086 (0.373)	0.69[c] (0.40)	-1.29[a] (0.41)	1.02[a] (0.22)	-0.30 (0.54)	6.66 (--)	R^2=0.27 F(22,842)=14.0
3	HR	2.67 (1.93)	3.35 (2.78)	0.032[b] (0.014)	-3.80[c] (1.95)	0.16 (0.59)	4.54[b] (1.80)	17.15 (11.72)	19.69[b] (9.77)	-6.48 (11.27)	-18.05 (13.13)	-0.88 (8.48)	-3.53 (3.05)	154.69[b] (64.94)	1.86 (1.26)	-37.52[a] (3.83)	27.46 (20.09)	-0.63 (1.36)	-63.41[b] (32.28)	-129.83[a] (29.11)	41.39[c] (22.79)	22.31 (15.13)	104.52[a] (36.52)	86.09 (--)	R^2=0.55 F(22,178)=9.8
4	DC	1.64[b] (0.74)	-1.38 (1.08)	0.017[a] (0.006)	-2.01[a] (0.80)	0.017 (0.242)	1.95[a] (0.47)	0.054 (4.547)	2.63 (4.00)	2.03 (5.56)	-8.90[c] (5.17)	2.38 (3.35)	-4.06[a] (0.86)	2.77 (22.01)	0.49 (0.48)	-12.91[a] (2.89)	0.29 (6.32)	1.21[b] (0.55)	2.22 (11.58)	24.62[c] (14.00)	-7.86 (9.67)	13.41[a] (4.89)	-8.96 (15.63)	126.46 (--)	R^2=0.43 F(22,253)=8.6
5	CBC	-0.12 (0.09)	0.23[b] (0.10)	-0.00049 (0.00083)	0.069 (0.077)	0.035[b] (0.016)	-0.065 (0.054)	-1.10[a] (0.41)	-0.18 (0.43)	0.10 (0.59)	0.17 (0.59)	-0.0050 (0.4068)	-0.15 (0.12)	-1.77 (2.01)	-0.071 (0.047)	-0.58[b] (0.26)	0.78 (0.76)	-0.012 (0.057)	1.83 (1.25)	2.97[a] (0.87)	-2.29[b] (0.93)	0.42 (0.39)	-2.92[b] (1.30)	15.63 (--)	R^2=0.32 F(22,236)=3.4
6	EKG	0.14 (0.10)	-0.26[b] (0.12)	0.0018[a] (0.0007)	0.34[a] (0.09)	-0.0053 (0.0204)	-0.100[c] (0.058)	0.33 (0.46)	0.37 (0.48)	-1.09 (0.71)	-1.57[a] (0.60)	-0.18 (0.48)	0.020 (0.117)	-4.69[c] (2.51)	-0.11[c] (0.06)	0.47 (0.34)	0.94 (0.84)	-0.057 (0.066)	4.83[a] (1.29)	1.03 (1.23)	0.20 (1.19)	0.43 (0.62)	-1.50 (1.63)	-29.88 (--)	R^2=0.35 F(22,362)=9.0
7	FHVR	2.63 (0.33)	-1.74[a] (0.45)	0.026[a] (0.003)	-0.48[c] (0.25)	-0.30[a] (0.08)	0.58[a] (0.22)	0.70 (2.25)	-6.45[a] (2.22)	0.64 (3.10)	-1.55 (2.87)	0.25 (0.21)												172.85 (--)	R^2=0.27 F(11,774)=26.1
8	FHVR	2.51[a] (0.34)	-0.59 (0.55)	0.028[a] (0.003)	-0.88[a] (0.29)	-0.12 (0.09)	0.25 (0.23)	1.37 (2.24)	-5.97 (2.20)	-0.045 (0.31)	-1.81 (2.88)	2.67 (2.05)							-3.25 (2.64)	-3.46 (4.14)	-10.86[a] (3.63)	10.69[a] (2.70)	9.60[c] (5.80)	-176.93 (—)	R^2=0.30 F(16,769)=20.3
9	FOVR	2.17[a] (0.26)	-2.10[a] (0.37)	0.018[a] (0.002)	0.32[c] (0.19)	-0.12[c] (0.06)	0.43[b] (0.17)	-8.54[a] (1.74)	0.92 (1.74)	-6.30[b] (2.49)	-2.97 (2.30)	-0.43 (0.16)												-144.01 (--)	R^2=0.30 F(11,853)=33.7
10	FOVR	2.04[a] (0.27)	-0.74[c] (0.44)	0.022[a] (0.002)	-0.27 (0.22)	0.036 (0.072)	0.24 (0.18)	-7.32[a] (1.71)	0.83 (1.71)	-6.14[a] (2.44)	-2.98 (2.28)	-0.31 (1.54)							-5.27[a] (2.00)	4.28 (3.29)	-12.22[a] (2.86)	6.82[a] (2.09)	-0.65 (4.65)	-148.15 (—)	R^2=0.34 F(16,848)=27.0
11	HRR	3.36[a] (0.61)	-2.94[a] (0.81)	0.024[a] (0.004)	-0.61 (0.39)	-0.034 (0.169)	0.78[c] (0.44)	-16.37[a] (4.66)	11.72[a] (4.14)	-10.12[b] (5.00)	-0.067 (0.057)	0.98[a] (0.38)												-194.00 (--)	R^2=0.39 F(11,180)=10.4
12	HRR	3.63[a] (0.69)	-2.74[a] (0.95)	0.029[a] (0.005)	-0.78[c] (0.45)	0.056 (0.199)	0.63 (0.47)	-12.17[a] (4.79)	10.78[a] (4.15)	-10.69[b] (4.92)	-5.47 (5.68)	9.66[a] (3.73)							-2.90 (5.28)	-16.93[c] (9.50)	-8.58 (5.81)	-6.26 (5.40)	15.30 (11.54)	-235.67 (--)	R^2=0.43 F(16,175)=8.2
13	DCR	3.25[a] (0.53)	-3.83[a] (0.71)	0.022[a] (0.004)	-0.52 (0.04)	-0.23[c] (0.13)	1.22[a] (0.33)	-16.75[a] (3.69)	-4.42 (3.57)	-4.64 (5.09)	-11.72[b] (4.681)	1.89 (3.05)												-153.06 (—)	R^2=0.46 F(11,264)=20.1
14	CBCR	2.22[a] (0.62)	0.67 (0.79)	0.023[a] (0.005)	0.55 (0.50)	0.16 (0.13)	-0.72[c] (0.40)	-9.88[b] (4.37)	7.83[c] (4.42)	-8.32 (6.10)	6.08 (5.77)	-3.34 (4.06)												-232.05 (—)	R^2=0.25 F(11,267)=8.2
15	CBCR	2.16[a] (0.66)	1.69[c] (0.87)	0.035[a] (0.006)	0.040 (0.554)	0.025 (0.141)	-0.57 (0.41)	-8.63[b] (4.18)	8.70 (4.33)	-5.08 (5.92)	5.32 (5.61)	-4.23 (3.92)							2.58 (6.60)	14.10[b] (6.76)	-17.10[a] (6.55)	-15.30[a] (4.70)	-20.09[b] (9.53)	-266.32 (--)	R^2=0.34 F(16,262)=8.3
16	EKGR	2.22[a] (0.17)	-1.39[a] (0.51)	0.020[a] (0.001)	0.068 (0.289)	-0.071 (0.089)	0.25 (0.25)	2.46 (2.44)	-4.24[c] (2.52)	-4.43 (3.78)	-7.30[b] (3.06)	-3.93 (2.55)												-155.33 (--)	R^2=0.30 F(11,373)=14.8

Notes: a. Statistically significant at the 1 percent level.
b. Statistically significant at the 5 percent level.
c. Statistically significant at the 10 percent level.

variables make a statistically significant contribution to explained variance (as gauged by a joint F-test) in all six regressions, and, hence, they are included in all payment level regressions in the table. With the ratio dependent variables, R^2s vary from 0.27 for one of the followup hospital visit regressions to 0.46 for the diagnostic D and C regression. Supply variables have been excluded from the latter set of regressions for conceptual reasons noted above. Regressions containing Medicaid program variables have been excluded in two cases (diagnostic D and C and electrocardiogram payment ratios) because a joint F-test indicated that these variables made no significant contribution to explained variance. In the remaining ratio regressions, these variables made a significant contribution at the 5 percent level or better.

On the whole, the ratio regression results are somewhat more easily interpreted. There are three reasons for this. First, some explanatory variables, such as per capita income (Y), affect both demand for redistribution on the part of the nonpoor (the "M" variables) and also possibly function as a supply-shift ("N") variable; in states with high per capita incomes, it is more profitable, ceteris paribus, for physicians to treat non-Medicaid patients. Similarly, the percentage black, while classified above as a M variable, could also shift the physician supply curve facing the Medicaid program. When $(S/\tilde{S})$ is the dependent variable, general conditions in the physicians' services market are held constant and the M variables are more easily intepreted as such. Second, the supply variables' impacts cannot be determined a priori. Hence, estimated coefficients of any sign are theoretically possible. In the ratio specification, supply variables are excluded. Third, the ratio of the Medicaid payment level to the physician's usual fee may in fact be the relevant decision variable for the Medicaid program. However, given the first two reasons, the third should be considered quite tentative.

Variables K, the Federal Medical Assistance Percentage, and POVP, the ratio of persons in poverty to the number of nonpoor in the state, have been designated above as price variables. A higher rate of federal subsidization should encourage states to adopt more generous Medicaid programs, holding other factors constant. As seen in Table 8-3, the Medicaid percentage has the expected positive impact on Medicaid payment levels in 5 out of 6 regressions and has a uniformly positive impact on the ratio dependent variables. Excluding the single case in which K shows a negative impact, associated K elasticities range from 0.19 (for followup office visit payments) to 1.08 (for diagnostic D and C payments) in the level regressions. Associated elasticities in the ratio regressions are substantially higher, from 1.50 (for complete blood count) to 2.78 (for inguinal hernia repair). In the latter specification, the coefficients themselves suggest the magnitude of the response to a change in the Medicaid percentage. For example, with reference to the 2.63 coefficient in regression 7, a 1 percentage point increase in the federal Medicaid percentage would increase Medicaid payments as a percentage of the physician's usual fee by 2.63 percentage points. In general, estimated parameters are reasonably insensitive to the number of explanatory variables included. For example, estimates of K's impact depend only to a small degree on whether or not the Medicaid program variables are included.

As expected, POVP has a negative impact on Medicaid payments in virtually all regressions. With Medicaid payment levels as the dependent variables, POVP's coefficient is negative and larger than its standard error in only one case (for diagnostic D and C); the elasticity associated with this coefficient is -0.20. By contrast, this variable demonstrates a significantly negative impact in almost all of the regressions with the ratio dependent variable. Associated elasticities range from -0.11 (regression 8) to -0.70 (regression 13). The POVP parameter estimate is positive in the case of complete blood count payment ratios; however, this is not the only respect in which the complete blood count results are anomalous.[24]

Variables Y through BLACK fall in the demand shift ("M") category. As noted above, when the dependent variable is the payment level for a particular procedure, it is difficult to distinguish M from N effects. With one exception, the Y coefficients are positive, as anticipated, in the payment level regressions; associated elasticities for the 5 positive coefficients range from 0.13 (for the follow-up office visit) to 1.61 (for electrocardiogram).

Estimated Y parameters in the ratio regressions, all positive, tend to be more precise, and the associated elasticities tend to be substantially larger. All estimated Y elasticities exceed 1.0 and some exceed 2.0. These results clearly indicate that more affluent states tend to adjust Medicaid payments closer to fee levels prevailing in private markets for physicians' services. Coefficients for the Republican percentage (RPUB), the percentage of persons in the state living in metropolitan areas (MET), and a percentage of persons in the state who are black (BLACK) tend to be much less precise and vary in sign. Two aspects about this set of coefficients merit emphasis. First, Medicaid payments tend to be lower in the more politically conservative states. Second, Table 8-3 provides no evidence that Medicaid payments are lower in states in which blacks constitute a substantial portion of the population. Yet this result runs counter to some previous research on public assistance.[25]

The supply shift variables appear only in the first 6 regressions. The N variables, results on wage rates (W), and the percentages of general practitioners (GP) and female doctors (FEM) in the state are the most readily interpreted. Higher wages do boost Medicaid payments; estimated effects, however, vary. While the wage effects for the two surgical procedures are small with associated elasticities of 0.14 and 0.01 for the hernia repair and diagnostic D and C regressions, respectively, the estimated impact for followup hospital visit payments is substantial with an associated elasticity of 0.74.

Medicaid reimbursement levels are generally lower in states with high proportions of general practitioners and female physicians. Results on the latter variable are particularly strong. No consistent patterns are evident from the physician availability (MD) and foreign medical school graduate proportion (FMG) coefficients.

The fact that some positive MD coefficients are obtained is noteworthy. Past studies of physicians' fees have often concluded that fees rise with increases in the area physician-population ratio.[26] In Table 8-3, some similar results are obtained for Medicaid payment levels. One possible reason for the unanticipated results in the physician fee studies is that third party reimbursements are higher in high physician availability areas. Clearly, several confounding influences must be disentangled before the relationship between physician availability and physicians' fees will be adequately understood.

The payment level regressions contain AMA, the proportion of physicians in the state belonging to the American Medical Association. In general, the AMA coefficients have an unanticipated negative sign. Similar results were obtained with ratio dependent variations (regressions were not reported in Table 8-3). To the extent that the AMA variable adequately measures power of organized medicine within the state, it appears that such groups have essentially no impact on Medicaid payment levels.

Variables FSCHD through ASPEC describe state Medicaid program structure. In general, the program coefficients are more instructive when the dependent variable is in ratio form. Two results are particularly noteworthy. First, when the program is housed in a health department, physicians tend to be paid a lower proportion of their usual fees. This result is consistent with the view that health departments are more clearly oriented toward institution-based (such as hospitals) medical care. Second, as noted above, a plausible case can be made for expecting Medicaid payments to be higher in areas where physicians are reimbursed on a UCR basis. Results in Table 8-3, however, are inconsistent with this. Judging from the FT18 coefficients, the proportion of the usual fee paid by Medicaid is not uniformly higher when Medicare reimbursement methods are employed by the state Medicaid program. Likewise, whereas negative fixed fee schedule (FSCHD) coefficients were anticipated, several positive ones are obtained. Thus there is no reason to single out UCR as an important source of growth in Medicaid outlays.

Finally, variables SPEC through AGE represent individual physician characteristics. In general, coefficients associated with relatively prestigious physician credentials, specialization (SPEC), board certification status (BCERT), and a clinical medical school appointment (FAC) are positive in the level and negative in the ratio regressions. Thus, even though there is some recognition of additional training and prestigious affiliations, payment levels generally do not keep pace with increases in physicians' usual fees. For this reason, it should come as no surprise that physicians with more prestigious credentials are less likely to accept Medicaid reimbursement as payment-in-full (Sloan, *et al*. 1978a and 1978b). The estimated parameters imply that foreign medical school graduates from third world countries (FMG) and older physicians are paid less by Medicaid; in these latter cases, signs of coefficients often vary, and the associated standard errors are relatively high.

FURTHER DISCUSSION, CONCLUSIONS, AND POLICY IMPLICATIONS

The Medicaid program was enacted in the mid-1960s to improve access of the poor to "mainstream" medicine. States were given rather substantial authority to develop their own programs within broad federal guidelines. Rather than mandate detailed federal standards, states have been provided a financial incentive to adopt generous programs. Given the realization that voter-taxpayers in less affluent states are less likely to adopt such programs, the rate of federal subsidization was specified to vary inversely with state per capita income in a recent (but historical) period. Even though utilization rates of the poor have risen, both absolutely and comparatively,[27] the poor still rely extensively on hospital-based clinic sources of care.[28] As noted above, there is now conclusive empirical evidence from past studies that office-based physicians' decisions to accept Medicaid patients depend to an important degree on the level of Medicaid payments and administrative hassles associated with collecting payments. This article has sought to discover why Medicaid payments vary and to identify policies that would induce states to vary generosity of Medicaid payments. Conversely, if policy-makers' goal is to limit public outlays of this nature, this study shows how that objective may be accomplished.

As emphasized above, even though payments to physicians represent slightly less than 10 percent of total Medicaid payments, far more is at stake when the office-based physician refuses to participate since the physician serves as the patient's health care broker. Without a personal physician agent, a patient is more likely to be pushed around from provider to provider and lack continuity of care.

Empirical estimates reported here for the physicians' component of Medicaid are quite supportive of the voter-taxpayer model of redistribution. At the same time, this study's analytic framework has only been applied to the physician component; although it is successful in explaining physician reimbursement patterns, it may or may not fit other dimensions of Medicaid as well.

The price variables have hypothesized effects on payments. Associated elasticities imply important impacts. Particularly when the dependent variable is expressed as the ratio of the Medicaid payment to the physician's usual fee for a particular procedure, estimated impacts are substantial. It is clear that by raising the Federal Medical Assistance Percentage, the tendency of states with low per capita incomes and high ratios of poor to nonpoor persons to severely limit reimbursement, can be offset.

Inferences about cyclical behavior derived from empirical analysis of a single cross-section are admittedly speculative. Yet the high estimated income elasticities in Table 8-3 suggest that Medicaid programs may attempt to curb procedure-specific payment levels during recessions. To the extent that such cuts naturally occur, it may be desirable for distributional reasons to vary FMAP counter-cyclically. Descriptive evidence suggests that Medicaid programs were subject to cuts during the 1974-75 recession.[29]

Although the voter-taxpayer model yields unambiguous predictions of the impacts of variables shifting the demand curve for redistirbution, the ways in which specific variables themselves affect demand are more complex. Presumably voters in states with large majorities for Nixon in 1972 tend to be more conservative on the whole, and hence substantial margins for Nixon are associated with inward shifts in citizen demand for income redistribution. The empirical results are consistent with this view. If the racial composition in a state is systematically related to voter discriminatory practices, one would observe inward demand shifts and hence lower Medicaid payments for specific procedures when there are large proportions of blacks. Using data from the mid-1970s, no meaningful differences in payment practices are found in this study. Given the political and civil rights gains of blacks since the mid-1960s, and results on other explanatory variables, failure to detect racial differences does not constitute evidence against the analytic framework. More important, from the vantage point of policy, this result is reassuring.

As noted earlier, it is not possible to deduce effects of shifts in the physician supply curve facing the Medicaid program. Certainly the positive estimated effects of wages paid non-physician personnel on payments is plausible as are the negative signs of the general practitioner and female physician percentage coefficients. Even though Medicaid programs appear to recognize differences in wage rates of non-physician personnel in part, Medicaid payment levels currently do not fully reflect wage differentials. The cost of this is reduced access of Medicaid recipients to office-based physicians. As in much past research on physician behavior, estimated impacts of overall physician availability reported in Table 8-3 are puzzling.[30] All these results permit one to say is that availability of doctors has no uniform impact on Medicaid payment policies, either negative or positive.

Whereas a model in which citizens purposefully determine both the extensiveness and nature of public programs has considerable appeal to economists, most noneconomists and many policymakers who have first-hand experience with government programs have difficulties with this view of the world. This is particularly true of open-ended entitlement programs such as public assistance. According to this latter view, programs, once established, have a life of their own because of (1) pressures from groups most directly affected by the programs, in the case of Medicaid, welfare recipients and health care providers; (2) numerous program decisions are inevitably beyond the scope of legislative authority and hence subject to bureaucratic discretion; and (3) the interplay among pressure groups, providers, and bureaucrats is inadequately understood by anyone. For the third reason in particular, it may be impossible to set key policy variables, such as K, and observe desired outcomes with any acceptable degree of certainty. On the whole, the Medicaid program variables make some, but not a great deal of contribution to explained variance with variables related to the voter-taxpayer model in the regressions. It is of course possible that additional program variables could have explained more, but the ones that have been included would probably be candidates for inclusion on anyone's list.

Certainly the fact that most Medicaid programs employ some form of UCR reimbursement raises the distinct possibility that Medicaid payment inflation is self-generating. No evidence is found for this here. It is quite possible that, given the lessons of the 1960s, third party payors have more recently implemented controls to curb the rise in payments under UCR. If so, emphasis on the inherent inflationary nature of UCR may be misplaced.

Further, it is known that agencies vary in the degree to which they are subject to political pressures from various constituencies. Since this study has examined only one aspect of the Medicaid program, judgments on this score should be seen as preliminary. In future research, it will be especially important to assess the implications on hospital, intermediate, and long-term facility payments of locating Medicaid programs in specific types of public agencies. The same suggestion is not necessary for UCR since this form of reimbursement pertains exclusively to physicians' services.

Finally, physicians differ substantially in terms of fees charged private patients. To a certain extent, variations in fees reflect physician characteristics traditionally associated with quality. It is entirely possible that voter-taxpayers believe that the poor are less entitled than others to the "cream of the physician crop." If, in fact, this is the case, current Medicaid practice of paying a lower fraction of the prestigious physician's fee is justified. However, if this is not the policy the public desires its Medicaid programs to pursue, additional effort to pay physicians on the basis of their credentials is in order.

FOOTNOTES TO CHAPTER 8

[1] Based on 1970 to 1977 expenditures on Medicaid programs. Source: U.S. Department of Commerce (1978), p. 99.

[2] See Feldstein (1971, 1973), Russell (1973), Burney, et al., (1978), Muller and Otelsberg (1979), and Schieber, et al. (1978).

[3] See U.S. Department of Health, Education, and Welfare (1978), p. 31.

[4] See, for example, Parker (1974) for further discussion of this point.

[5] See Hadley and Lee (1978), Held, et al. (1978), and Sloan, et al. (1978a, 1978b).

[6] See Holahan, et al. (1977), pp. 24-25.

[7] U.S. Department of Health, Education, and Welfare (1978).

[8] As of 1975-76, 24 percent of U.S. physicians refused to accept Medicaid patients (Sloan, Cromwell, and Mitchell (1978a)).

[9] For an assessment of copayments' effects on use of Medicaid services, see Helms, et al. (1978).

[10] For example, states must provide certain basic services, but, even for these, states have latitude in setting certain standards.

[11] States are required to reimburse hospitals on the same basis as Medicare unless granted an exemption from the Secretary of Health, Education, and Welfare.

[12] In Medicare terminology, UCR is CPR ("customary, prevailing, and reasonable"). The principles underlying the payment method are the same.

[13] See, for example, State of Michigan (1973).

[14] U.S. Department of Health, Education, and Welfare (1978), pp. 20-21.

[15] U.S. Department of Health, Education, and Welfare (1978), p. 85.

[16] The analytically correct variable is the number of persons in poverty, not the number of welfare recipients. The latter variable was used in an analysis of AFDC by Orr (1976).

[17] Presumably an increase in the FMAP would raise the voters' federal tax obligation. But spread over 50 states, this change would be very small and thus is neglected in the calculations summarized in Table 1. Orr's (1976) theoretical analysis of AFDC programs explicitly recognizes this change.

[18] Further detail on the physician surveys in provided in Sloan, et al. (1978b).

[19] The dependent variable S and wage index are deflated by a PSU-specific price index described in Institute of Medicine (1976); monetarily-expressed variables defined for the physician's state are deflated by a state price index described in Steinwald and Sloan (1974). Both deflators are based on U.S. Bureau of Labor Statistics area cost-of-living data; since they are based on the same data source, they are closely-related.

[20] See Health Policy Center (1979).

[21] See, for example, studies of AFDC by Orr (1976) and Sloan (1977). A study of state public expenditures on health and hospitals by Vogel and Morrall (1973) reveals that these expenditures are positively related to the state black population proportion.

[22] AMA is publicly available only for 1970. See American Medical Association (1971). Fortunately, this percentage is likely to change rather slowly.

[23] To some extent, the list of individual characteristics is dictated by data availability. Unfortunately, no data on physician sex are available from the regional NORC survey; however, the NORC microdata file permits one to construct a more satisfactory measure of the foreign medical school graduate effect than is possible at the state level. Data on board certification and faculty affiliation are not publicly available for states. For purposes of constructing FMG, all graduates of Mexican medical schools were considered to be domestic graduates; many Mexican graduates are Americans who studied there.

[24] Payment patterns for complete blood counts (and presumably other lab procedures as well) appear to differ markedly from those for visits. For evidence on Medicare, see Muller and Otelsberg (1979); on Blue Shield, see Sloan (1979).

[25] See footnote 21.

[26] See, for example, Dyckman (1978).

[27] Davis and Schoen (1978).

[28] Sloan and Bentkover (1979).

[29] See Holahan, et al. (1979) and U.S. Department of Health, Education, and Welfare (1978). For a more general discussion of counter-cyclical revenue sharing, see Vogel and Trost (1979) and references provided there.

[30] In research on Blue Shield payments to physicians using the same data base, I obtained similar results on physician availability.

SECTION V

HOSPITAL-BASED PHYSICIANS: ANALYSIS AND PUBLIC POLICY

Chapter 9

Hospital-Based Physicians: Current Issues and Descriptive Evidence

Bruce Steinwald

INTRODUCTION

In recent years, the issues surrounding the use and cost of ancillary hospital services have established a strong foothold in the debate over inflation in health care expenditures. The term "hospital-based physician" (HBP) has evolved to distinguished physicians who provide ancillary services from the majority of office-based MD's who supply the bulk of physicians' services to the consuming public.[1] Most office-based physicians typically provide many of their services in hospitals, but their practices are not nearly so integrated with hospital facilities and personnel as are the practices of HBPs, who generally do not maintain offices outside the hospital.

This paper contains information on physicians in the three "traditional" HBP specialties of anesthesiology, pathology, and radiology, with emphasis on the latter two. These specialties represent a preponderance of HBP services, but there has been considerable growth in other types of practices confined to the hospital, including cardiology, electrodiagnosis, and emergency medicine.[2] In addition, the growth of full-time chiefs of service has added not only to the fraction of physicians who are based in the hospital but also to the spectrum of specialties represented in hospital-based practice. Thus, many of the issues discussed below extend well beyond the three specialties specifically addressed.

The next section, which identifies policy issues that distinguish HBPs from office-based physicians, is followed by a section that examines trends in HBP compensation over the past 15 years and offers a partial explanation for changes during this period. Cross-sectional evidence on selected characteristics of HBP practices, including some comparisons with office-based physicians, is then presented. Summary and concluding remarks are contained in the final section.

ISSUES

How are HBPs different from office-based MDs in ways that inspire policy interest? Incomes of HBPs, particularly radiologists and pathologists, tend to be higher, on average, than most office-based MDs' income. Part of the interest in HBP incomes is due to the vast differences between salaried HBPs and those who are paid on a "piecework" basis, generally either through fee-for-service or a percentage of departmental revenue (Arthur Andersen and Co., 1977). While physicians' incomes have long been a topic of some controversy, it is worth noting that radiology and pathology are among the few specialties that have received criticism from within the medical profession.[3] High incomes, of course, are not a sufficient cause for alarm and certainly could not be used as the basis for regulatory intervention. But in a market that is known to depart in significant ways from the competitive ideal, high incomes represent an attention-getting signal in the policy milieu.

One very plausible explanation for current levels of HBP incomes is based on the notion of temporary disequilibrium arising from vast increases in demand for ancillary services. Available evidence indicates that recently the use of ancillary services has grown even more than the overall use of basic hospital services (Scitovsky, 1977; Scitovsky and McCall, 1977; Redisch, 1978), but this observation is accompained by some suspicion about underlying causes. Technological advances have created new diagnostic and theraupetic ancillary procedures that have been of incalculable benefit to many patients, but there is also cause to believe that "defensive medicine" accounts for a large part of this growth.[4] No one knows how many lab tests and X-rays are performed solely to reduce the threat of malpractice litigation, but this trend represents a major obstacle to controlling inflation in health service expenditures.

Several structural characteristics of HBP practices have attracted policy interest in recent years. One is the nature and variety of HBP compensation methods, alluded to above, which will be discussed in the next section. Another is cross-subsidization, a term that describes the traditional pricing system in many hospitals whereby some services are priced much higher, relative to costs, than others. The system involves generation of excess revenues from HBP departments, especially radiology and pathology, to subsidize net losses in other departments (Ammer, 1971; Redich, 1978; Somers and Somers, 1967). The misallocation of resources and non-competitive behavior implied by this system make cross-subsidization a natural target for regulation. Consequently, it has encountered resistance from several state hospital rate review agencies.[5]

A structural feature of HBP practices that falls within the purview of antitrust enforcement agencies is what industrial organization economists term "exclusive dealing" arrangements.[6] Hospitals typically supply the space, equipment, and staffing to HBPs under arrangements that exclude competing HBPs from using these resources.[7] Such arrangements may not precisely fit the criteria for antitrust enforcement specified under the antitrust laws and established precedents, and their effect on competion in the physicians' services market is certainly not clear. Yet despite what appears to be a current hiatus in antitrust activity in the health sector, we may expect more attention to be paid to hospital-HBP exclusive arrangements in the future.

A final characteristic of HBP practices that is relevant to current health policy relates to the role of government as a monitor of health service expenditures. Increased government purchase of health services plus inflation in this sector have intensified public demands for accountability. Regulatory programs have, for the most part, developed separately for hospital and physician services, and herein lies a problem for monitoring HBP service expenditures. Because there is so much variation in methods by which HBPs and hospitals share department revenues and expenses, none of the information sources on hospitals or physicians is very thorough for tracking trends in HBP department expenditures. Also, none of the regulatory programs is particularly well suited to this task. Consequently, there is considerable support for accountability-enhancing programs such as Senator Talmadge's proposal to reform reimbursement under Medicare and Medicaid (95th Congress, S. 1470), which would limit hospital-HBP arrangements that have proved most difficult to monitor in the past.

Thus, there is policy interest in HBP practices on several fronts, and related issues tend to be unresolved. The next section adopts a historical view toward trends in methods of HBP compensation, a subject which takes a prominent place in nearly all policy discussions involving HBPs.

COMPENSATION OF HOSPITAL-BASED PHYSICIANS

Methods of Compensation

At the heart of most issues concerning HBPs are the arrangements negotiated by HBPs and hospitals regarding the distribution of revenues and costs pertaining to HBP department services. At present, very little is known about how these arrangements affect HBP productivity, unit costs of service, and volume of services delivered. Only slightly more information exists on the association between compensation methods and HBP incomes. Such questions clearly have policy relevance; it would be very risky for Congress or regulatory agencies to promulgate policies affecting HBP-hospital relationships without understanding how such relationships are determined or how they affect patient costs and use of health services.

There are three primary ways that HBPs are compensated for their services--salary, percentage of department revenue, and fee-for-service.[8] With the understanding that these methods are often found in combination and seldom exist in pure form, the following definitions are offered.

Major variants of the salary method:

- All HBP department MDs are employees of the hospital and receive a salary for their services.
- Some HBP department MDs are salaried by other department MDs (or by the HBP practice) who receive compensation for the practice's services via some other method.

The second variant typically occurs when a young HBP, or one new to a geographic area, is employed by an older, more established HBP. In some instances, the hospital negotiates its arrangements only with the department chief. Hospitals with all HBPs in a department on salary tend to be larger, teaching hospitals. In this case, the compensation method is influenced by other considerations such as membership on a medical school faculty.

Major variants of the percentage method:

- The HBP practice receives a specified percentage of gross department billings (sometimes after deductions for charity, bad debts, and/or discounts).
- The HBP practice receives a percentage of net department revenues (gross billings less deductions and department expenses).

Until recently, percent of department revenue was the most prevalent method of paying pathologists and radiologists, with percent-of-gross being much more frequently used than percent-of-net. Percent-of-net is the more difficult of the two systems to implement because of potential ambiguities in calculating net revenues (Reals, 1977; American Hospital Association 1976) and potential legal complexities (Horty, 1972). Departures from these definitional arrangements include instances where HBPs pay for some departmental inputs under percent-of-gross arrangements (Matthews, 1973) and instances where not all costs are allocated to HBP departments under percent-of-net arrangements. Such departures tend to narrow the differences between the two percentage forms of compensation.

Major variants of the fee-for-service method:

- The HBP practice bills patients for professional services and the hospital bills patients separately for non-professional services.
- All billing is done by the hospital which compensates the HBP practice a specified amount for each service performed.
- All billing is done by the practice which compensates the hospital for the use of its facilities and staff.

The first and second methods are far more common than the third, which is typically organized as a leasing arrangement whereby the practice runs the HBP department and leases the hospital's facilities and equipment. Fee-for-service has traditionally been the prevalent method of reimbursing anesthesiologists and has become increasingly important, in recent years, for pathologists and radiologists. For the latter two specialties, it is common for the hospital to do the billing for both professional and non-professional services. When the hospital acts as the HBP practice's bill collector, economies arising from combined billing may be realized.[9]

Other methods of compensating HBPs, such as salary plus percentage arrangements, are primarily combinations of the basic types. In addition, it is not uncommon to observe minimum guarantee and maximum remuneration provisions in arrangements governing HBP compensation by the hospital.[10] Such provisions can change the nature of compensation dramatically. For example, a precentage arrangement with an HBP revenue ceiling below the specified percent times actual department revenue in essence becomes a salary-like compensation system--at the margin, changes in department output have no effect on HBP income. Suffice it to say that HBP compensation tends to be much more complex than the definitions and statistics presented in this section would suggest.

Incentives associated with different HBP compensation methods comprise another complex subject. Discussions of HBP incentives in the literature are largely conjectural as there is no unified theory on which to draw in this area, nor is there much useful empirical evidence.[12] Further, it is essential to recognize that selection of a compensation system is endogenous to both HBP and hospital decision making. Incentives are certainly important, but we know for too little at present about joint physician-hospital behavior to be able to compare incentives under the different HBP compensation methods on the basis of common sense reasoning or intuition alone.

An appropriate starting point for comparing different HBP compensation arrangements is to ask why, in a system dominated by fee-for-service medicine, salary and percentage arrangements have proliferated. The answer probably lies in the nature of HBPs outputs (keeping in mind that there are substantial differences among HBP specialties). In particular, the services of pathologists and radiologists tend to be produced in relatively small units, such as lab tests and X-rays, and direct physician-patient contacts are uncommon.[13] The costs of billing patients for HBP services are relatively large compared to charges, making economies in billing practices relatively important compared to other types of medical practice. A comparison between percentage compensation (with all billing done by the hospital) and separate fee-for-service billing by the HBP practice, two popular compensation arrangements, is useful to illustrate this point.

Under the percentage arrangement, the hospital sends a single bill to patients (or third parties) for ancillary services delivered. Once revenues have been accumulated for a specified period, the HBP share is calculated by applying the predetermined fixed percentage. Unless the third-party payer requires it (as Medicare does), there is no need for the hospital to relate HBP compensation to the performance of specific services because the percentage application subsumes this process.

Under separate fee-for-service billing, both the hospital and the HBP practice submit bills, doubling (or nearly so) the number, if not the cost, of transactions to collect revenues. In addition, the physician, who typically in radiology and pathology departments has not seen the patient and may not have been directly involved in the patient's workup, must prepare charges in terms of specific patient services, a task that may be onerous. Moreover, patients sometimes object to being billed by physicians that they have not seen personally (Hitt, 1977). Thus, one can appreciate that, in the past, transaction cost considerations have made percentage compensation arrangements relatively advantageous.

Most of the transaction cost advantages of percentage compensation are available under salaried HBP compensation as well. Historically, there has been some resistance to salaried physician compensation within the medical profession, but the proportion of HBPs on salary has remained well above the corresponding proportion for physicians in office-based specialties. One should not assume that it is resistance of physicians alone that works against salaried HBP compensation. Hospitals may prefer percentage or even fee-for-service HBP compensation if such "piecework" arrangements, relative to salary, are perceived to expand HBP department revenues.[14]

Trends in HBP Compensation

Of all characteristics of HBP practices, by far the most studied is the hospital-HBP compensation arrangement. Inferences can be drawn about compensation distribution changes in the post-Medicare period from data on HBP compensation from 1965 to 1978. However, because of differing data sources, assumptions, and definitions, statistics produced by different studies are not sufficiently comparable to calculate precise changes in these distributions. With this limitation in mind, data from six studies and 10 years have been reduced to estimated distributions, in percentage form, of HBP compensation among the three primary compensation types: salary, percentage, and fee-for-service.[15] Distributions for pathologists and radiologists are shown in Table 9-1.

Data sources for the 10 surveys are reported in the footnote to Table 9-1. Some of the major differences between these surveys that limit data comparability are notable. First, the hospital is the data source in all studies except (10), the HCFA-NORC surveys, in which the physician is the data source.[16] Study (9) also reports data pertaining to physicians. In all other studies the hospital is the unit of observation, except that (2) and (5) weight hospitals by bed size. Studies (2), (5), (7), and (8) report data pertaining to HBP department chiefs. Studies (1), (3), (4), and (6) use American Hospital Association (AHA) survey data without specifying whether reported arrangements pertain to all or a subset of department HBPs. Since the hospital is the unit of observation in these studies, it is likely that hospitals with multiple arrangements in a single department also reported the arrangement with the department chief. This probably has the effect of underestimating the proportion of salaries HBPs, since physician employees of non-salaried HBPs would be excluded from these distributions.

The studies vary considerably in sampling methods, sample sizes, and definitions of compensation arrangements. For example, the proportions of arrangements reported as "other," the category eliminated from Table 9-1, ranged from a low of three percent to a high of 19 percent. A detailed

Table 9-1: "Best Estimate" Distributions of Methods of Compensating Pathologists and Radiologists Among Three Primary Compensation Methods, 1965-1978, in Percent.

Data Source[1]:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Year of Data	1965	1965	1965	1966	1968	1969	1972	1974	1975	1977-78
Pathologists										
Salary	25	28	23	25	28	19	17	21	33	45
Percentage	55	48	62	53	41	50	54	47	46	15
Fee for Service	20	24	15	22	31	31	29	32	21	40
	100	100	100	100	100	100	100	100	100	100
Radiologists										
Salary	15	20	12	15	18	7	6	10	18	13
Percentage	73	69	82	67	46	64	64	56	41	20
Fee for Service	12	11	6	18	36	29	30	34	41	67
	100	100	100	100	100	100	100	100	100	100

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[1] Data sources (full citations are in references section): (1) and (4), Somers and Somers (1967); (2) and (5), Van Dyke, et al. (1968); (3) and (6), Begole, et al. (1972); (7), Blakely (1973); (8) Modern Healthcare (1974) [(7) and (8) both report fundings of surveys performed by A. T. Kearney, Inc.]; (9) Arthur Andersen and Co. (1977); (10) HCFA-NORC Surveys, 1977-1978.

Note: The hospital is the data source in all of the studies cited above with the exception of (10). The HCFA-NORC Surveys use the physician as the data source.

examination of these differences is beyond the scope of this analysis; it is sufficient to say that Table 9-1's figures should not be accepted uncritically.

With these limitations in mind, the table does reveal some discernible tendencies. First, there are four study pairs [(1) and (4), (2) and (5), (3) and (6), and (7) and (8)] that report information on two years.[17] Because each survey in a pair uses the same data sources and collection techniques, within-pair findings should be comparable. The three pairs reporting data beginning in 1965 indicate unchanging or slightly declining use of salaried HBP compensation, moderate to pronounced decreases in percentage compensation, and definite increases in fee-for-service compensation. The study pair for the years 1972 and 1974 reports similar trends, except that salaried compensation increased slightly. Taken as a whole, the studies strongly suggest a decline in percentage compensation of HBPs and a concomitant increase in fee-for-service compensation since 1965.

The HCFA-NORC data [study (10) in Table 9-1] merit the most attention because they are the most current, are based on a probability sample of physicians, and were obtained via telephone interview rather than questionnaire. Sampling variation, definitional differences, and the sampling unit (physicians rather than hospitals) no doubt account for some of the differences in compensation distributions between this source and the others represented in the table.[18] However, the same trends are apparent in the HCFA-NORC data as in the rest of the table. Percentage compensation of HBPs is definitely declining. Among radiologists, the trend is toward fee-for-service compensation. Among pathologists, the decline in percentage compensation is accompanied by increases in both fee-for-service and salaried compensation.

Pathologists would logically be more inclined toward salaried practice and radiologists toward fee-for-service because the costs of transactions of fee-for-service practice are relatively higher for pathologists than radiologists. Radiology services tend to be produced in larger units than pathology services, and the radiologist typically reads X-rays while the pathologist participates directly in only a small fraction of lab tests.

We cannot hope to discover causes for these trends in HBP compensation through statistical methods, but we can make some deduction through examining events that have occurred in the past 15 years. The following scenario, which relies heavily on the role of Medicare and Medicaid (established as a result of the Social Security Amendments of 1965), is offered as a partial explanation of the trend away from percentage compensation of pathologists and radiologists.[19]

Prior to implementation of Medicare in 1966, hospital-based practice was relatively stable, much more so than is suggested by Table 9-1's statistics on HBP compensation between 1965 and 1978. Pre-Medicare, the major issue concerning HBPs was organized medicine's fight against "the corporate practice of medicine" (Somers and Somers, 1967), which centered on the legality and professional ethics of hospitals' submitting bills and collecting fees for services rendered by HBPs. In some states, this practice was declared illegal; by the 1960s, however, restrictions had diminished, and hospitals and HBPs were largely left alone to negotiate mutually acceptable compensation arrangements (Somers and Somers, 1961).

Before Medicare, separate fee-for-service billing by pathologists and radiologists was extremely rare.[20] At this time there was little incentive to incur the extra costs of separate billing for hospital and HBP services. Most third parties, including Blue Cross, covered HBP services as a part of hospitalization benefits (Somers and Somers, 1967). Percentage compensation was a logical, low cost method for hospitals and physicians to divide revenues earned by pathology and radiology departments.[21]

Medicare threw a monkey wrench into the relationships between hospitals and HBPs by requiring separation of charges for professional and hospital services. A physician's time is considered a professional service only if it is performed in person by the physician and contributes to the diagnosis or treatment of the patient. Other services performed by HBPs are considered hospital services (Federal Register, 1980). The separation requirement created substantial clerical demands and, more importantly, undermined many of the advantages of financial integration of hospital and HBP activities.[22] Not surprisingly, representatives of HBPs (especially the American College of Radiology, the College of American Pathologists, and the American Medical Association) protested vigorously against the way in which the Medicare regulations were written.[23]

Prior to Medicare's implementation, the "optional method" of payment was devised to allow the hospital to submit bills for HBP services without an item-by-item separation of the professional and non-professional components. Instead, the professional component may be identified as a fixed proportion of the total bill for services. As required by law, the optional method must result in a hospital-professional split that would not differ significantly from the aggregate split when bills are itemized. Moreover, this provision did not release HBPs from the necessity of determining which of their services are chargeable under Part B of Medicare as professional services and which must be charged under Part A as hospital services.[24]

The Social Security Amendments of 1967 made some further changes in the regulations governing payment for HBP services, also designed to reduce administrative burdens and promote integration between HBPs and hospitals. The 1967 Amendments allowed all radiology and pathology services rendered to in-patients to be charged to the hospital (Part A) portion of Medicare at 100 percent of reasonable charges.[25] This provision was intended to reduce HBP incentives for separate billing and thereby reduce processing costs to providers and to the Social Security Administration, even though it made more federal dollars available for financing HBP services.

Judging from the figures in Table 9-1, these concessions did little to halt the trend toward separate billing fee-for-service practice of HBPs. As far as Medicare is concerned, this trend can be ascribed to two factors. First, Medicare's principles of reimbursement, by requiring separation of professional and non-professional components, have reduced the transactions cost advantages of combined hospital-HBP billing compared to separate fee-for-service billing by HBPs. Second, Medicare and its companion program, Medicaid, vastly increased the amount of third-party dollars available to pay for private fees charged by HBPs. To what degree the trends in HBP compensation can be attributed to these factors is uncertain; we have no way of knowing what would have happened in the absence of Medicare or with a law designed specifically not to interfere with existing integrated charging and remuneration systems. Yet, apart from increased private insurance coverage in the 1960s and 1970s for ambulatory health services generally, it is difficult to identify other factors that could have exerted so great an influence.[26]

A PROFILE OF HBP PRACTICES

This section presents a statistical profile of selected attributes of HBP practices based on the HCFA-NORC survey of physicians conducted in 1977 and 1978. These statistics are contained in Table 9-2, 9-3, and 9-4. The tables also contain data on office-based physicians.[27] Data on anesthesiologists as well as pathologists and radiologists are included. In some respects anesthesiologists are more akin to office-based MDs (particularly surgeons) than other HBPs. Anesthesiologists' outputs are more discrete and these HBPs are predominately fee-for-service practitioners who directly provide services to patients. While most of the controversy surrounding HBPs focuses on pathologists and radiologists, inclusion of statistics on anesthesiologists is useful for comparative purposes.

Some of the differences between anesthesiologists and other HBPs are apparent in Table 9-2. The former are much more likely to be independent (that is, non-contract) solo practitioners who confine their practices to a single hospital. The vast majority of pathologists and radiologists are in non-solo practices on contract with one or more hospitals or clinics. The expansiveness of pathology and radiology departments is reflected in the proportions of such departments with equipment acquisitions costing over $5,000. Roughly one-third of these departments had such acquisitions in 1976.

The second part of Table 9-2 indicates the degree to which HBP practice costs are subsidized by hospitals and clinics. The level of subsidy is highest for pathologists. Although these levels are generally very high compared to office-based MDs, they are not 100 percent as conventional wisdom would suggest. Many HBPs do pay for all or part of certain inputs, particularly personnel. These proportions are consistent with data comparing average net to gross revenues in Table 9-4.

The last part of Table 9-3 gives working time averages for HBPs. Radiologists and pathologists tend to have fewer hours of work than anesthesiologists and office-based MDs. (Office-based MDs averaged 47.4 weeks practiced in 1976; in a representative week in 1977 they spent 60.1 hours in medical activities and 4.6 hours in administrative activities.) The fraction of total hours devoted to administrative activities is relatively high for

Table9-2: Selected Practice Characteristics of Hospital-Based Physicians, 1976 and 1977

Percent of HBPs:	Anesthesiologists	Pathologists	Radiologists
• in solo practice, 1977	55.2	19.2	19.3
• with multiple hospital affiliations, 1977	17.2	17.8	26.8
• with secondary practices, 1977	13.7	29.6	25.1
• on contract with hospitals, 1977	48.7	95.4	86.3
• on contract with clinics, 1977	1.8	15.8	24.8
• in departments with equipment acquisition costing over $5,000	1.4	31.8	37.3
Percent of HBPs with Total or Partial Subsidies from Hospitals or Clinics in 1976 for the Following Practice Inputs [1]			
• personnel	52.5	81.6	52.4
• office space and utilities	88.2	84.6	74.8
• medical equipment	73.0	86.0	78.5
• medical supplies	87.2	88.5	79.8
Working Time			
• weeks practiced, 1976	47.4	47.7	47.4
• hours per week spent in medical activities, 1977 [2]	60.6	51.1	56.0
• hours per week spent in administrative activities, 1977 [2]	4.3	8.1	4.8

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[1] Non-employed HBPs only.

[2] Hours data pertain to a representative week in 1977. Medical activities include time spent making rounds, supervising employees on medical tasks, traveling to and from sites of medical practice, etc. Administrative activities include time spent filling out insurance forms, billing patients, supervising employees on financial and other non-medical tasks, etc.

Source: HCFA-NORC Survey, 1977

pathologists, which is not surprising given the nature of practice in this specialty.

Table 9-3 presents information on insurance coverage of patients of HBPs and office-based MDs. Several studies have demonstrated that insurance exerts a major influence on the behavior of patients and health service providers. The first part of Table 9-3 gives distribtuions of patient insurance coverage by specialty and the second part provides data on the extent to which fees for common HBP and non-HBP procedures are covered by the different insurers. Insurers are listed in order of generosity of payment from least to most generous. This ordering is consistent over all types of procedures--Medicaid is least generous, followed by Medicare (Part B), Blue Shield, and commercial insurance. Differences in average proportions of fees covered among the four types of insurance programs are often substantial.

Anesthesiologists have the lowest proportion of patients without coverage for their services, probably because surgical services tend to be relatively well-covered. The coverage figures for office-based MDs represent a wide range of surgical and non-surgical procedures. HBPs tend to have a slightly higher proportion of patients covered by Medicare and/or Medicaid (coverage under these two programs often overlaps) and a lower proportion covered by commercial insurance than office-based MDs.

For comparative purposes, two procedures were selected for office-based MDs in the second part of Table 9-3--follow-up office visit (a common non-surgical procedure) and hernia repair (a common surgical procedure). Holding insurer constant, HBPs tend to have a slightly higher proportion of their fees covered than office-based MDs. For each insurer, pathologists tend to have the highest proportion of fees covered and radiologists are next. Coverage for anesthesia services is lowest among the HBP specialties.

Table 9-3: Distribution of Patient Insurance Coverage and Mean Proportions of Fees Covered by Insurer for Selected Procedures, 1977

	Distribution of Patient Insurance Coverage (%)[1]				
	No Coverage	Medicaid	Medicare Part B	Blue Shield	Commercial Insurance
Anesthesiologists	8.3	13.7	28.0	37.5	27.6
Pathologists	12.1	13.3	27.4	41.5	11.9
Radiologists	12.8	14.5	27.7	39.5	20.4
Office-Based MDs	11.6	12.9	26.2	37.6	28.1

	Mean Fees and Mean Proportions of Fees Covered				
	Fee	Medicaid	Medicare Part B	Blue Shield	Commercial Insurance
Anesthesiologists: Anesthesia for 30 Minute Tonsillectomy	$ 93.76	0.523	0.703	0.869	0.932
Pathologists: Complete Blood Count	$ 8.19	0.801	0.815	0.954	0.968
Radiologists: Chest X-ray	$ 14.87	0.687	0.799	0.958	0.945
Office-Based MDs: Follow-up Office Visit	$ 13.91	0.642	0.758	0.884	0.921
Surgical Hernia Repair	$624.	0.544	0.749	0.885	0.914

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[1] Percentages add to more than 100 due to overlapping coverage

Source: HCFA-NORC Survey, 1977

Differences in distribution of insurance coverage and proportions of fees covered between hospital-based and office-based MDs are slight and, to some extent, offsetting. Therefore, based on Table 9-3's statistics, one would not expect patient insurance coverage to cause HBP behavior to differ markedly from that of office-based MDs.[28]

Table 9-4 presents income figures by specialty broken down by the three primary methods of HBP compensation.[29] Office-based MD income statistics are presented under fee-for-service headings; the very few non-fee-for-service office-based physicians were omitted from calculation of these statistics. This table clearly indicates that the HBP specialties are considerably more lucrative than office-based specialties taken as a whole. This is true regardless of whether one uses net income or adjusted net income (which incorporates deferred income) per hour of medical activity as the measure of income.[30] The most lucrative HBP specialty is radiology, followed by pathology and anesthesiology. These findings are generally consistent with past research on HBP incomes by specialty (Gaffney and Glandon, 1979; Arthur Anderson and Co., 1977).

Table 9-4 indicates that fee-for-service practice is the most lucrative form of HBP compensation for anesthesiologists and radiologists, and percentage compensation is most lucrative for pathologists. Salaried compensation is the least lucrative for all HBP specialties. The difference between salaried and fee-for-service compensation is greatest for radiologists and least for anesthesiologists. Although it is very risky to infer reasons underlying trends from cross-sectional data, one can see that, other things being equal, fee-for-service practice offers a more attractive alternative to percentage arrangements than salaried practice. Indeed, these statistics suggest that departure from percentage arrangements causes few financial hardships for

le 9-4: Mean Gross and Net Physician Incomes by Compensation Method, 1976-77

	Anesthesiologists	(n)	Pathologists	(n)	Radiologists	(n)	Office-Based MDs	(n)
ss Income Per FTE MD								
Salary	$ 80,168	(39)	$ 68,135	(83)	$ 79,361	(46)	---	
Percentage	90,793	(19)	113,742	(25)	146,028	(59)	---	
Fee for Service	112,356	(222)	160,564	(66)	138,297	(213)	$130,600	(6475)
All[1]	106,278	(304)	109,953	(182)	130,605	(336)	---	
Income Per FTE MD								
Salary	$53,614	(38)	$53,196	(83)	$51,342	(41)	---	
Percentage	63,235	(19)	79,571	(29)	71,968	(66)	---	
Fee for Service	64,908	(233)	74,737	(71)	77,697	(219)	$59,254	(6752)
All[1]	63,810	(311)	65,004	(192)	73,322	(344)	---	
io of Net to Gross Income								
Salary	0.758	(35)	0.800	(81)	0.805	(38)	---	
Percentage	0.715	(17)	0.703	(23)	0.603	(56)	---	
Fee for Service	0.645	(202)	0.716	(53)	0.662	(179)	0.555	(5479)
All[1]	0.665	(277)	0.751	(163)	0.666	(289)	---	
erred Income								
Salary	$ 7,616	(32)	$ 5,427	(78)	$ 8,294	(30)	---	
Percentage	10,208	(19)	10,892	(32)	12,474	(51)	---	
Fee for Service	11,886	(225)	12,789	(67)	15,459	(212)	$7,196	(6569)
All[1]	11,436	(296)	8,985	(188)	14,234	(325)	---	
justed Net Income per ir of Medical Activity[2]								
Salary	$26.54	(26)	$29.37	(72)	$25.76	(25)	---	
Percentage	23.12	(16)	43.21	(28)	33.61	(53)	---	
Fee for Service	28.93	(195)	40.06	(60)	40.00	(186)	$24.64	(5392)
All[1]	28.41	(254)	35.83	(167)	37.55	(280)	---	

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he "All" category includes some HBPs with "other/unknown" methods of compensation.

Estimates of deferred income are added to reported net income for computing adjusted net income per hour of medical activity.

urce: HCFA-NORC Surveys, 1977 and 1978.

HBPs who switch to fee-for-service practice. However, on financial grounds alone, salaried practice does appear to be a relatively unattractive alternative for radiologists and pathologists.[31]

As one would expect, net income to gross income ratios are higher for HBPs than for office-based MDs, and these ratios tend to be higher for salaried HBPs than for non-salaried. However, these differences are not as great as *a priori* expectations. Two things account for differences between gross and net practice incomes. First, many physicians defer income through pension plans and other means, and deferred income is not included in reported net income (although it is included in gross income).[32] Table 9-4 indicates that HBPs tend to have considerably higher levels of deferred income than office-based MDs, and non-salaried HBPs tend to have more deferred income than their salaried counterparts. Second, many HBPs, like office-based MDs (but to a lesser extent), incur practice expenses. Combined with the information on input subsidies in Table 9-2, these statistics tend to refute the conventional wisdom that hospitals and clinics provide all the non-MD resources for production of services in HBP departments.

Income data presented in Table 9-4 are roughly comparable to survey findings generated by the American Medical Association (AMA). Based on data provided in Gaffney and Glandon (1979), net income per hour in 1978 was estimated to be $28.37 for anesthesiologists, $34.00 for radiologists, and $25.89 for all non-federal patient-care MDs (including both office- and hospital-based MDs). Compared to statistics based on HCFA-NORC data in Table 9-4, the AMA figures are for a slightly different time period, do not take deferred income into account, and use a slightly different definition of hours of work.

Data presented by Arthur Andersen and Co. (1977) imply that inflation-adjusted HBP incomes are much higher than those shown in Table 9-4. Comparability between Arthur Andersen data and HCFA-NORC data, however, is severly limited. Findings of the Arthur Andersen study suggest that the ranking of the three HBP specialties in lucrativeness is the same as shown in the table and that net incomes per hour of effort of salaried HBPs are considerably below these of non-salaried HBPs. In these respects the HCFA-NORC and Arthur Andersen data are consistent, but further comparisons would be unwarranted.[33]

In summary, descriptive statistics derived from the 1977 and 1978 HCFA-NORC surveys are generally supportive of conventional beliefs about HBPs, but these data contain some surprises as well. For example, the level at which HBPs, including those on salary, incur practice expenses, is unexpected. Insurance coverage distributions reveal slight differences between HBPs' and office-based MDs' practices, but in the aggregate, they indicate nothing that would lead one to expect major behavioral differences. The ranking of average earnings of the three HBP specialties, with radiology the highest, followed by pathology and anesthesiology, is consistent with the findings of past research, as is the finding that HBPs tend to earn substantially more than office-based MDs. In the aggregate, the income statistics indicate no important financial disincentives to the movement of radiologists and pathologists away from percentage to fee-for-service compensation. They do, however, reveal substantial financial barriers to salary compensation.

SUMMARY AND IMPLICATIONS

High HBP incomes, growth in ancillary service expenditures, methods of HBP compensation, cross-subsidization in hospital pricing structures, exclusive dealing arrangements between HBPs and hospitals, and lack of accountability for HBP service expenditures are all sources of policy unrest concerning hospital-based physicians. Lack of reliable information on HBP practices and trends intensifies this unrest. Based primarily on data from the 1977 and 1978

HCFA-NORC surveys of physicians, this paper has attempted to fill in part of the information gap. It remains to summarize some of the highlights of the descriptive analysis and discuss implications for the future.

Cross-sectional evidence on practice characteristics reveals that there are both differences and similarities between the three HBP specialties studied. Anesthesiologists most resemble office-based practitioners in their preference for independent, direct billing, fee-for-service practice. The proportion of radiologists receiving compensation via fee-for-service, however, is nearly as high. In contrast, a far greater proportion of pathologists receive salaried compensation for their services. All HBPs tend to have practice costs heavily subsidized by hospitals, but evidence on specific input expenses and practice deductions indicates that these subsidies are not as high as conventional wisdom would suggest.

Distributions of insurance coverage indicate that HBPs tend to have slightly more patients with Medicare and Medicaid coverage and fewer patients with commercial insurance coverage than office-based MDs. Of the three HBP specialties, anesthesiologists have the lowest proportion of patients without coverage and the highest with multiple coverage, probably reflecting more thorough coverage for surgical services than for ancillary services generally. In terms of percent of fees covered, commercial insurers tend to be the most generous third parties, followed by Blue Shield, Medicare-Part B, and Medicaid. Holding insurer constant, HBPs tend to have higher proportions of their fees covered than office-based MDs, which offsets, to an uncertain extent, the high proportion of patients covered by relatively low-paying insurance programs among HBPs.

Data from the HCFA-NORC surveys support past evidence that hospital-based practice is considerably more lucrative than office-based, on average. Estimated mean net income per hour of medical activity in 1976-77 ranged from

15 percent higher for anesthesiologists to 53 percent higher for radiologists. On a per-hour basis, fee-for-service is the most lucrative form of HBP compensation, followed closely by percentage of department revenue and not so closely by salaried compensation.

Trend data contained in Table 9-1 indicates a movement away from percentage compensation of pathologists and radiologists since enactment of Medicare in 1965. Reductions in percentage compensation have been accompanied by increases in both salaried and fee-for-service compensation of pathologists and by increases in fee-for-service compensation of radiologists. Medicare's regulations regarding identification of a professional component in physician billing under Part B are probably an important factor in the movement away from percentage compensation. If reduced transaction costs were a major reason underlying HBPs' and hospitals' historical preferences for percentage compensation arrangements, this advantage has largely eroded. In addition, the increase in third-party funds to pay for physicians' services generally has certainly contributed to making fee-for-service practice relatively more attractive to HBPs.

The future of HBPs _vis à vis_ regulatory activities and other exogenous influences is uncertain, but some further changes seem imminent. In particular, passage of the Talmadge Bill or similar legislation may sound the death knell for percentage forms of compensation. Such legislation would not make percentage compensation illegal, but would probably remove most remaining advantages, pushing even more HBPs into fee-for-service or salaried compensation.[34] Primarily because of monitoring difficulties, many health policy analysts will be glad to see percentage compensation of HBPs disappear. However, it should be recognized that this change is not without costs. To the extent that some HBPs and hospitals have been influenced to switch from percentage to fee-for-service arrangements, the transaction costs of billing and collecting for HBP department services have probably increased, although we currently have no way of isolating these cost increases. Even so, the greater ease in monitoring HBP service charges and utilization which has accompanied the change in compensation arrangements may be sufficient to justify the added costs.

One development affecting HBPs at the state level is particularly worthy of mention. The State of Maryland's Health Services Cost Review Commission is currently engaged in a court battle to establish jurisdiction over fees charged by hospital-based physicians (cardiologists, radiologists, and pathologists) as a part of its hospital rate-setting authority.[38] This action was precipitated by a 1976 dispute over the Commission's decision to reduce compensation of HBPs at a hospital in Silver Spring, Maryland. The HBPs and hospital brought the matter before the county circuit court in 1977. The court found in favor of the Commission (i.e., that the Commission did have jurisdiction to regulate HBP fees) because the services of these MDs were regarded as hospital services and therefore the costs associated with those services were subject to regulation (at the time this action was initiated, the cardiologists were compensated on a percentage basis and the pathologists and radiologists were on fee-for-service, and all billing was done by the hospital). On appeal, the Maryland Court of Appeals determined that the fundamental issue in the case had not been settled in the circuit court; namely, whether fees charged by HBPs could legitimately be regarded as part of the total costs of the hospital. The case was therefore remanded to the county circuit court for resolution of this issue, which was the status of the case as of Spring, 1980.[39]

If the Maryland Health Services Cost Review Commission obtains rate review jurisdiction over fees charged by hospital-based specialists, this will establish an important precedent. Regardless of how the case turns out, there are likely to be some "threat effects" of the prospect of HBP fee control by hospital rate regulation agencies. Such agencies presently exist in several states, and we may expect more to be created by state legislatures as time goes by.[37] If traditional arrangements between HBPs and hospitals will be regarded as a criterion for establishing authority to regulate fees, this may be an additional incentive for HBPs to switch to direct billing fee-for-service remuneration.

Thus, there are currently several forces at work that have had, and will probably continue to have, dramatic effects on the organization and financing of hospital-based physician services. If, on the basis of evidence and discussion presented in this paper, it seems that hospital-based medical practice is beset with problems for the policymaker, these problems cannot be laid at the doorstep of the HBPs alone. It should be clear that the proper focus is on the whole system of physicians, hospitals, and payment mechanisms that have created the circumstances described here. On the other hand, evidence on incomes, trends, and structural characteristics suggests that HBPs may have been the beneficiaries of windfall gains arising from these circumstances. Therefore, they should not be surprised if they attract more than their "fair share" of attention as the regulatory process expands its activity in the health services sector in the 1980s.

FOOTNOTES TO CHAPTER 9

1. The only unambiguous definition of the term "hospital-based physician" was developed by the American Medical Association in the mid-1960s (see Gaffney and Glandon, 1979). A primary criterion of the AMA definition is that such physicians are employed on salary by the hospital. Because this criterion would be inappropriate in the present context, the less precise but more generic definition that relies on the degree of physician integration with the hospital is used in this paper.

2. See, for example, "Full-Time Physicians in Hospitals" (1974), Michela (1977), and Kaskiw (1978).

3. See Kastal (1972), Rourke (1972), and various occasional letters and short pieces that appear from time to time in non-technical professional journals such as Medical Economics, Medical World News, and Hospital Physician.

4. According to a 1976-77 survey of physicians by the American Medical Association, over one-third of respondents indicated that the malpractice litigation threat had caused them to order more tests and procedures for their patients than in previous years (Henderson, 1979).

5. As the growth of prospective reimbursement and hospital rate review continues, we may expect increasingly critical scrutiny of cross-subsidization. For example, Maryland's Health Services Cost Review Commission has substantially restricted the amount of cross-subsidization allowable in Maryland hospitals' rate structures (Cohen, 1978).

6. See Scherer (1970), Chapter 21, for a general discussion of exclusive dealing arrangements and Thompson (1979), Havighurst (1980), and Calvani and James (1980) for applications to the health field.

7. In an article very critical of the non-competitive features of hospital-HBP arrangements, Gabel and Redisch (1978) refer to HBPs as "the franchised monopolists" because of their ability to obtain exclusive rights to the use of department resources.

8. This list is somewhat simplified. For other categorizations and discussion, see Van Dyke *et al*. (1968), Arthur Andersen and Co. (1977), American Hospital Association (1976), and Kaskiw (1978).

9. It is important to distinguish between HBP compensation and billing for HBP services. Compensation refers to how HBPs are paid and billing refers to how HBP services are charged; there is no necessary relationship between the two activities. For example, Medicare's principles of reimbursement require separation of professional and non-professional services in billings for HBP services. Physicians' professional services are reimbursed by Part B on the basis of reasonable charges and nonprofessional services (for example, supervision of technicians) are reimbursed by Part A on the basis of reasonable costs. This separation, by law, must take place regardless of how HBPs are paid. The role of Medicare in trends in HBP compensation is further discussed later in this section.

11. That such ceilings are sometimes in effect is apparent in unpublished data provided to the author by the College of American Pathologists. I am grateful to Dr. William Hartmann for procuring these data.

12. For discussions of HBP incentives, see Ammer (1971), Blakely (1973), Kaskiw (1978), Gabel and Redisch (1978), and Hellinger (1979). The latter source provides the most extensive theoretical discussion of incentives as well as some empirical tests.

13. Hospital-based physicians tend to engage in far more supervisory and administrative activities than office-based physicians. See, for example, Hartmann and Gardner (1977) for a detailed description of the professional and administrative functions of pathologists.

14. It is reasonable to assume that hospitals' preferences for piecework arrangements are, in part, dependent upon their ability to implement a policy of cross-subsidization through their pricing decisions. Where third parties and regulatory agencies restrict cross-subsidization, hospitals may have relatively greater preference for salaried HBP remuneration. However, evidence presented by Hellinger (1979) indicates that departments having HBPs on salary do not have lower volume of output than departments where HBPs are on percentage compensation. Hellinger's work illustrates the fallibility of conventional wisdom in this area.

15. Where possible, compensation arrangements have been included under one of the three basic types. (For example, leasing arrangements have been included under fee-for-service.) Uncategorizable arrangements have been eliminated from Table 1 and the percentages of the three basic types of compensation were normalized to add to 100. This enhances our ability to trace compensation method changes over time.

16. The HCFA-NORC surveys were initiated in 1976 in response to a perceived need for more thorough and regular data on physicians' practices than were available from other sources. In 1977, the survey was broadened to include development of a modified instrument to accommodate the special characteristics of HBPs in anesthesiology, pathology, and radiology. The HCFA-NORC surveys use telephone interviews of physicians and their employees as the primary data collection technique. The overall response rate for both office-based and hospital-based physicians was approximately 70 percent in 1977 and approximately 65.5 percent in 1978. Responses were obtained from 543 HBPs in 1977 and 501 HBPs in 1978. Table 1 combines these responses to reduce sampling variation apparent in the data.

17. Van Dyke et al. actually reported data for four years, 1965-68. Because inclusion of all four years' data would give too much weight to one study, only the end years are reported in Table 1.

18. Fee-for-service and "a fixed percentage of each charge" are treated as equivalent in the HCFA-NORC survey instrument. This may have resulted in some arrangements that researchers would classify as percentage being recorded as fee-for-service.

19. Descriptions of the status of HBP practice during the period of Medicare's enactment are based largely on Herman and Anne Somers' excellent analysis in Medicare and the Hospitals (1967). With remarkable foresight, the Somers' predicted widespread movement of HBPs to separate billing, fee-for-service practice following implementation of Medicare.

20. Somers and Somers (1967) reported that as of December 31, 1965, 11.1 percent of pathologists and 12.5 percent of radiologists billed directly. The authors maintain that these figures probably include some shifts to direct billing immediately prior to collection of these data (after passage but before implementation of the Medicare law). Some early surveys did not even include fee-for-service as a specified alternative in questions on HBP compensation. See Begole et al. (1972) and Steinle (1970). The latter source provides some evidence that percentage arrangements were even more prevalent in the late 1950s than in the mid-1960s.

21. Of course, salaried HBP compensation should also be associated with relatively low transaction costs in billing for HBP services. Figures presented in Dyckman (1976), based on Internal Revenue Service data (wherein the physician is the unit of observation), suggest that the proportion of pathologists and radiologists receiving a salary as their primary form of compensation in 1965 was considerably higher than corresponding proportions for 1965 based on studies reported in Table 1. Given the different methodologies, etc., of these studies discussed in the previous section, and the trends suggested by Table 1, the conclusion of Gabel and Redisch (1978)—that Medicare brought about a decline in salary compensation of HBPs—may be mistaken.

22. Somers and Somers (1967) refer to the separation provision as "the Medicare blunder."

23. Major objections of medical organizations to Medicare's principles of reimbursement for HBP services and SSA's responses to these objections are summarized in Willcox (1966). Gabel and Redisch (1978) and Hellinger (1979) express the view that these principles increased the economic power of HBPs in their negotiations with hospitals.

24. This discussion describes only the tip of the iceberg of Medicare's principles and procedures for reimbursement of HBP services. See McKibben (1978) for a more detailed summary.

25. Reimbursements to physicians under Part B of Medicare are made on the basis of "customary-prevailing-reasonable" criteria. A physician's fee meets the customary criterion if it does not exceed what she/he has customarily charged for a period of time, and the prevailing criterion is met if the fee does not exceed the 75th percentile of fees charged for the same procedure by other physicians in a locality. If both these criteria are met, or if a higher fee can be justified on the basis of extenuating circumstances, the fee is deemed reasonable. Medicare reimbursements under Part B are subject to deductible provisions and are limited to 80 percent of reasonable charges. See Sloan and Steinwald (1975) for a more detailed discussion of this procedure.

26. According to Gabel and Redisch (1978), Medicare and Medicaid accounted for 37 percent of aggregate hospital revenues in 1976 and probably for an even higher proportion in HBP departments.

27. Data on office-based MDs were obtained from a slightly different instrument than the one used to survey HBPs. The office-based MD survey was conducted at the same time as the HBP surveys and encompassed a representative sample of 17 office-based specialties. See footnote 16.

28. This discussion ignores potential relationships between coverage distributions and fee levels, a distinct possibility. However, in the aggregate, no such relationship is apparent in these data.

29. Table 4's statistics are based on combined responses from the 1977 and 1978 HCFA-NORC surveys. Thus, the income and related figures are averaged over 1976 and 1977. The survey data were combined because breaking down these figures by compensation method reduces cell sizes, and pooling two years reduces sampling variation considerably.

30. Net income was adjusted by adding estimates of deferred income (e.g., pension plans) to realized net income before dividing by estimated hours spent in medical activities in 1976. The hours estimates are the product of weeks worked in 1976 times hours worked in a reference week in 1977 (see Table 2). Hours spent in medical activities rather than total hours were used as the denominator mainly because the hours figures reported by HCFA-NORC survey respondents were rather high compared to past evidence on physician working time. For example, AMA data on total hours worked per week in 1978 reported in Gaffney and Glandon (1979), which are based on a larger number of respondents than the HCFA-NORC surveys, show mean hours for anesthesiologists of 50.3 and for radiologists of 47.8 (Table 16, p. 203); pathologists' hours were not reported). Use of medical rather than total hours has the effect of increasing (slightly) the per hour income figures, but it does not greatly affect income comparisons, with one exception. Because they devote a relatively high proportion of their time to administrative activities, the net income per hour statistics pertaining to pathologists are probably a bit inflated. For comparative purposes, these averages should be about 5 to 10 percent lower than the figures shown in Table 4, although this does not change the findings qualitatively.

31. These remarks must be tempered by the fact that income figures reported in Table 4 do not include the value of fringe benefits which are higher under salaried practice than the alternative forms of practice. For example, the proportion of salaried HBPs receiving life and/or health insurance benefits in 1977 was about 70 to 75 percent, while the corresponding proportion for non-salaried HBPs was on the order of 15 to 30 percent. However, many of these benefits, such as malpractice insurance, would be practice expenses if not subsidized by hospitals. Therefore, the net income statistics partially account for differences in fringes. It should be emphasized that salaried HBPs are often members of medical school faculties, and these physicians, both HBPs and office-based MDs, typically earn less than their non-teaching colleagues.

32. The HCFA-NORC survey question on deferred income is expressed in terms of "pensions, profit-sharing, and retirement programs." There is a distinct possibility that some other forms of deferred income were excluded and the reported figures are therefore underestimated. Of course, this possibility applies to both office-based and hospital-based MDs.

33. Arthur Andersen and Co. (1977) reported HBP income data that were (1) estimated from hospital disbursements to HBPs; (2) exclusive of all direct billing fee-for-service HBPs; (3) gross income figures only; and (4) adjusted to a "full time equivalent" (FTE) basis, with 2080 hours per year = 1 FTE. The Arthur Andersen report created quite a stir when it was released because it was used as the basis for a recommendation by Ralph Nader's Health Research Group in a letter to Joseph Califano that all HBPs should be placed on a salary in order to save the public millions of dollars in health care costs. (Partially because Arthur Andersen reported gross income figures, there was a wide disparity between reported salaried and non-salaried HBP incomes). Naturally, the recommendation was enthusiastically criticized by a variety of medical organizations. See "Nader's Hospital-MD Salary Plan Attacked" (1977).

34. In early debates over the Talmadge proposal, organized medical groups, particularly the College of American Pathologists, fought the provisions so unfavorable to percentage compensation, but in later debates these provisions seem to have been grudgingly accepted. See U.S. Senate (1977).

35. Holy Cross Hospital of Silver Spring, Inc. et al., v. Health Services Cost Review Commission (1977, 1978, 1980). These documents and a verbal summary of the case were generously provided by Stanley Lustman, Assistant Attorney General, State of Maryland.

36. In May 1980, the circuit court found in favor of the commission by determining that the costs of the HBP services in question were indeed part of the total costs of the hospital and therefore subject to control by the commission. However, the circuit court also created a loophole by adding a passage stating that HBPs can avoid commission jurisdiction by billing patients directly for their services. Both sides are appealing the circuit court's decision.

37. According to a survey conducted by the American Hospital Association (Boeh, 1979), state-created agencies empowered to regulate hospital rates existed in eight states in 1979. In addition, voluntary programs with authority to control rates, many of them operated by local Blue Cross plans, existed in thirteen states in 1979.

Chapter 10

Incomes, Expenses, and Outputs of Hospital-Based Physicians: A Multivariate Analysis

Bruce Steinwald

INTRODUCTION

Most economic research on physicians has focused on office-based MDs in major specialties such as general practice, internal medicine, and surgery. Recently, growing attention has been paid to hospital-based physicians (HBPs), the radiologists, pathologists, and other MDs who provide all their services in hospitals and clinics and whose practices are intertwined with the labor and nonlabor resources of the facilities where they work. High incomes in these specialties have inspired the interest of policy makers and analysts and have directed attention to the idiosyncratic structural features of this corner of the physician services market. In particular, HBP contractual and compensation arrangements with hospitals have raised questions of relevance to antitrust enforcement agencies and to agencies responsible for monitoring and reimbursement of health care expenditures covered by Social Security Act programs. Expenditures for ancillary hospital services, those most often performed in HBP departments, have increased at a faster rate than hospital costs generally, which intensifies policy interest in HBPs.[1]

This chapter has a primary and a secondary objective. The primary objective is to identify and estimate determinants of variations in elements of HBP practice performance: incomes, expenses, and outputs. The empirical research is guided by the methodological approaches and specifications of past research on office-based physicians. The secondary objective is to identify factors that account for choice of compensation arrangement of HBPs and to determine how compensation arrangements, in turn, influence practice performance. This objective follows from the emphasis placed on HBP compensation arrangements in recent literature and policy debates on this topic.

As illustrated in Chapter 9, HBP compensation arrangements, particularly of pathologists and radiologists, have been studied periodically since the mid-1970s.[2] Although many arrangements exist, the vast majority can be reduced to salary, percentage of department revenue, and fee-for-service. Compared to office-based MDs, a far greater proportion of HBPs are salaried. Moreover, percentage compensation, wherein the HBP receives a fixed percentage of department gross or net (usually gross) revenues, has no analog in office-based practice. Percentage compensation used to be the dominant method of remunerating pathologists and radiologists in the mid-1960s and before, but use of this method has been declining since then. Both fee-for-service and salaried compensation have become more prevalent for pathologists but only fee-for-service compensation has increased for radiologists.[3] In contrast, anesthesiologists have traditionally been primarily fee-for-service practitioners for decades; however, a small but persistent proportion of anesthesiologists are compensated by salary or percentage of department revenues.

In the remainder of this chapter, a brief section on methodological approach is followed by sections which present the empirical specification and findings. Conclusions and implications are discussed in the final section.

DATA AND EMPIRICAL APPROACH

The HCFA-NORC physician surveys conducted in 1977 and 1978 comprise the primary data base for the empirical analysis. Overall response rates to both office-based and hospital-based physician surveys were approximately 70 percent in 1977 and 65.5 percent in 1978. Responses were obtained from 543 HBPs in 1977 and 501 HBPs in 1978. These responses were pooled to increase the number of cases for the empirical analysis. Because the HCFA-NORC surveys are based on cluster samples of physicians, responses are weighted to approximate a probability distribution.[4]

Two other important data sources are the American Medical Association's Physician Masterfile and the Bureau of Health Manpower's Area Resource File. The AMA source provides reasonably current data on physicians' personal and professional characteristics. The Area Resource File (ARF) contains area (county, SMSA, or state) data on a wide variety of characteristics of geographic areas, including health-related resources.

Dependent variables selected for the analysis are measures of HBP incomes, expenses, and output per unit of time. A behavioral model is adopted with guidance from past empirical research on physicians. Theoretical work on physician behavior is in a state of flux, particularly with regard to the issue of demand creation.[5] One is tempted to discount the notion of demand creation in analysis of HBPs because these MDs typically do not initiate services--their patients are under the control of physicians in other specialties. Yet HBPs are not totally immune from this issue. Radiologists and pathologists often influence the number of X-rays taken and lab tests performed once a patient is slated for diagnostic work, and anesthesiologists determine the type and amount of anesthesia administered. Thus, the matter of demand creation cannot be dismissed entirely. Still, there is no doubt that HBPs differ in significant ways from office-based physicians, and empirical work on HBP economic performance may provide some useful comparisons with past research on office-based MDs.

The major innovation of this research relates to HBP compensation arrangements. Most research on physician behavior generally has assumed a single compensation system--fee-for-service. This system, of course, does not account for all office-based physician compensation; some are salaried by institutions and a few, functioning within groups serving Health Maintenance Organizations (HMOs), are paid on a capitation basis.

But as stated earlier, a much greater proportion of HBPs uses non-fee-for-service compensation.[6]

Hospitals and HBPs jointly select or negotiate the systems by which HBPs are compensated (or, alternatively, how revenues generated in HBP departments are to be divided). Although considerable evidence now exists on compensation arrangement distributions and trends, the process by which the different arrangements are selected is another one of those "black boxes" of hospital-MD behavior--very little information exists on how such arrangements are determined. Because HBP departments are important revenue centers in most hospitals, and because compensation methods are strongly associated with HBP incomes, methods of revenue division must be seen as an important matter by both parties. Net revenues of salaried HBPs do not vary with department output or revenue, at least in the short run. Non-salaried (percentage or fee-for-service) HBPs' incomes do vary with department revenue. These two "piece work" systems appear to be very similar in regard to HBP incentives toward generating additional revenue. The main difference between the two, in terms of what can be shown with available evidence, is that percentage HBPs more often receive compensation from hospitals (which collect revenues on behalf of themselves and their HBPs) while fee-for-service HBPs more often bill patients directly.[7]

The HBP compensation method is appropriately viewed as endogenous in systems that determine HBP revenues and related attributes of practice performance. Earlier, compensation method selection was characterized as a process of negotiation between HBPs and hospitals. This does not imply that compensation methods are constantly renegotiable, however; from the HBP's standpoint, selection of a compensation method may be the outcome of selection of a hospital where medical staff membership is available and the pecuniary and nonpecuniary arrangements are acceptable in the aggregate. The compensation method may influence both the total revenues generated by a HBP department and the division of revenues (and expenses) between HBPs and the hospital. The method selected therefore depends on the goals, constraints, and bargaining power of both HBPs and hospitals. A limitation of the present analysis is that no data are available on the hospitals where the HBPs included in the empirical analysis are situated.[8] Thus, selection of a compensation method is physician-dependent in the present analysis.

Because there are three distinct compensation methods, logit is an appropriate estimator for the compensation method regressions.[9] Separate logit regressions were estimated for each of the three specialties, yielding (with appropriate transformations) predicted probabilities of each of the three compensation methods for each HBP in the sample. The compensation method predictions enter the HBP performance regressions as explanatory variables.

EMPIRICAL SPECIFICATION

Dependent Variables

Dependent variables selected for the analysis are measures of HBPs' net incomes, gross incomes and expenses, and output per unit of time, with emphasis on net incomes. Emphasis on net incomes is due to two factors: (1) most policy debates involving HBPs focus on the (relatively high) incomes earned by physicians in HBP specialties, and (2) net incomes are better measured on the HCFA-NORC surveys than the other dependent variables. Two measures of net income are included in the analysis. The first is reported net income after practice deductions and before taxes.[10] The second measure adds an estimate of deferred net income (set asides for pensions and profit sharing) to original net income to arrive at a total net income estimate.[11] This is a conceptually better measure of net income, but it is prone to some ambiguity and a relatively high proportion of missing values. For these reasons, both net income measures are included. In addition, an estimate of number of hours spent in medical activities for the income year is used to compute net income per hour estimates, yielding a total of four net income dependent variables.

Gross income and practice deductions are also included as dependent variables. Gross income is subject to some errors in variable because it is reported for the entire practice, requiring a somewhat cumbersome process to calculate gross income per full-time equivalent (FTE) HBP. Deductions are subject to the same problem.[12] Output measures do not reflect the gamut of services performed by HBPs. Rather, the general categories "X-rays" for radiologists, "laboratory tests" for pathologists, and "operations and assists" for anesthesiologists are each divided by the number of hours devoted by the HBP in reference weeks in 1976 and 1977 to generating these outputs. Heterogeneity among HBPs within specialties in the nature of these outputs is an important source of errors in variables in the output measures.

Independent Variables

Independent variables reflect the combined effects of physicians' personal and professional characteristics, characteristics of the physician's market, insurance coverage distributions, and compensation method. All monetary dependent and independent variables are deflated by an area cost of living index and expressed in 1977 dollars.[13] The analysis does not contain variables representing practice costs due to the anomalous nature of hospital-HBP relationships. Most physicians use hospital-owned (and paid for) resources to produce physicians' services, but this characteristic of medicine is much more extensive in hospital-based practice. The analysis below is constructed to capture some determinants of the degree of hospital-subsidized inputs available to HBPs which, ex ante, is probably more important as an income determinant than factor prices of specific inputs.[14]

Physicians' personal characteristics identify attributes associated with perceptions of quality or expected levels of effort in the market. FEMALE takes the value one if the physician's sex is female. We know from other accounts (Kehrer, 1976; Sloan, 1975) that female MDs tend to devote less medical effort than males, suggesting a negative impact on net income. If the market values female MDs less highly, or if females are less aggressive in maximizing incomes, this effect will be negative on income per hour as well. FMG takes the value one if the physician was educated at a non-U.S., non-Canadian medical school. Foreign medical school graduates (FMGs) are widely felt to have had lower quality medical training and language and racial differences may act as barriers to entry into the more lucrative avenues of HBP practice. The expected effect of FMG on all income variables is unambiguously negative.

Two variables represent the physician's age and vintage of medical education. AGE60 and GRAD10 take the value one, respectively, if the physician was 60 years of age or older or if the physician had graduated from medical school within 10 years of the survey date. Both variables are hypothesized to have a negative impact on net income--AGE 60 because the shadow price of time is expected to increase at older ages resulting in a lessening of market time, and GRAD10 because many of these younger MDs are still building practices and may not have reached full capacity. Hypothesized effects of these variables on income per hour is somewhat ambiguous, however; older physicians may have obtained favorable arrangements (e.g., analogous to "franchise" ownerships; see Gabel and Redisch, 1978) and younger MDs are the beneficiaries of newer vintage medical educations and price competition in medicine is not widely employed by entrants to increase volume of practice.

Variables BOARD and CHIEF take the value one, respectively, if the MD is board certified in a HBP specialty or is the chief of a hospital department. BOARD is a well-recognized and frequently utilized credentials variable and is expected to have a positive effect on all income variables. CHIEF represents additional attributes not captured by the other personal characteristics variables (e.g., leadership) or, alternatively, may be viewed as indicating the premium paid to MDs who undertake the responsibility of department leadership. Either view implies a positive effect on the income variables.

The variables S2 and S3 take the value one, respectively, if the size of the HBP practice is two to four MDs or five to ten MDs (practices with over 10 MDs were excluded from the HCFA-NORC sample). Solo practices, including employed MDs, constitute the omitted category. These scale variables are included to detect a relationship between practice size and HBP incomes which may arise from economies of scale or other factors. Most larger practices are associated with larger hospitals; in addition, larger practices probably indicate the presence of collective rather than atomistic bargaining with hospital administration in some hospitals. All of these factors suggest positive signs of the included practice size variables in income regressions.

The variables PTH and RAD take the value one, respectively, if the physician is a pathologist or radiologist, with anesthesiologists as the omitted category in the regressions. Simple income distributions based on HCFA-NORC survey data presented in Chapter 9 show that radiology is the most lucrative HBP specialty followed by pathology and anesthesiology, in that order, suggesting that both PTH and RAD should be positive and the latter the higher in absolute value.[15] However, whether these relationships hold up when all other variables are held constant is an empirical matter.

Area characteristics of the physician's market are represented by PERCAP, OMDPOP, HMDBED, and RATE. The variable PERCAP is mean per capita income of the HBP's county. Because several studies have demonstrated a positive income elasticity of the demand for medical care, the hypothesized effect of PERCAP on physician earnings is umambiguously positive.[16]

OMDPOP is the number of office-based patient care MDs per 1000 county population. Its effect on HBP earnings depends on whether HBPs and office-based MDs are, on average, substitutes or complements. Most HBP services are initiated by referral from office-based MDs, which argues in favor of the complementarity hypothesis. However, office-based MDs under some circumstances may perform some of the services also performed by HBPs--for example, internists may perform some of their own lab tests and surgeons their own anesthesia. Intuitively, it seems more likely that complementarity would dominate, suggesting a positive effect on HBP incomes, but this matter is best treated as an empirical issue.

HMDBED is the number of HBPs defined to be specialty specific (i.e., county anesthesiologists for anesthesiologists in the sample, etc.) per county community hospital bed. Beds was selected as the denominator of this variable rather than county population for two reasons. First, beds represent the availability of hospital capital for use by HBPs as practice inputs; where HMDBED is relatively low (i.e., more capital available per HBP) greater availability of hospital capital implies higher earnings of HBPs. Indeed, hospitals may actively promote or encourage arrangements that create incentives for increased usage of capital in HBP departments under such circumstances. Second, hospital-based MDs per unit of population is highly collinear with OMDPOP, making it impossible to enter both variables defined in this way in a regression equation. Having beds as the denominator in HMDBED breaks this collinearity.

The variable RATE takes the value one if the HBP's state has a mandatory, statutory hospital rate regulation program.[17] Inclusion of this variable is based on the previously discussed close association between HBPs and hospitals. Mandatory rate review, often associated with a prospective reimbursement program that delves into hospital contractual and other relationships, places constraints on hospital behavior that may, in some cases, influence HBP practice performance. An example is the degree to which a hospital is able to maintain a system of cross-subsidization in pricing services within different hospital revenue centers. Typically, HBP departments tend to generate excess revenues to subsidize net losses of the less profitable revenue centers. Cross-subsidization is a practice amenable to restriction by regulatory agencies (where they exist and have the power to do so) and because under many arrangements the revenue of HBPs is tied to revenue of the department, restrictions imposed by rate review agencies may have a depressing effect on HBP incomes.[18] In addition, the rate regulation variable acts as a proxy for regulatory climate in a state. Those states where the climate is most restrictive and public demand for cost control measures is highest are most likely to have such agencies. This interpretation, as well as the more explicit one, both imply a negative effect of RATE on HBP incomes.

The multivariate specification, consistent with past research on physician behavior, also includes variables representing distribution of insurance coverage of patients treated by HBPs in the sample. Insurance coverage data have been transformed into proportions of coverage that add to 1.00 for each physician in the sample. The four insurance groups represented are Medicaid, Medicare, private health insurance, and uninsured (the omitted category in the regressions). Insurance is known to positively influence demand for health services and for this reason one might expect all of the included variables to display positive signs in the income regressions. However, insurance programs normally institute controls on amounts payable to physicians based on the notion of "reasonable charges" and these controls present some constraints to physicians' incomes. Medicaid provides the most serious constraints because Medicaid maximum payments (reasonable charges) tend to be lowest of all third parties covering physicians' services and especially because Medicaid does not allow the physician to charge the patient any more than what the Medicaid insurance carrier will pay. Other insurers, Medicare and private, allow the physician to charge the patient for fees in excess of the third party's maximum payment, although in doing so they often incur significant transaction costs. The constraints placed on Medicaid charges may dominate the downward pressure on incomes of treating uninsured patients, suggesting a negative impact of the Medicaid proportion on HBP incomes. Other parameter estimates, MCARE and PVINS, are expected to be positive.

The final independent variables indicate the HBP's compensation method. The variables P2 and P3, respectively, are predicted probabilities that the HBP is compensated on a percentage of department revenue or fee-for-service basis. The predicted probability of salaried compensation is held constant in the regressions. Logit regressions from which the predictions were calculated are presented in Appendix F. HBP practice performance regressions were also estimated with actual rather than predicted compensation method as dummy variables. The variables R2 and R3, representing percentage and fee-for-service HBPs, respectively, are analogous to the variables P2 and P3. The variable R4 indicates HBPs with other or unknown methods of compensation.[19] Because compensation method is endogenous in the HBP performance regressions, the regression variants with the P variables merit more confidence than those with the R variables representing compensation method. Yet the logit regressions did not yield very precise estimates of compensation method determination and the R variable variants are reported because they provide a useful supplement in some instances of interpreting parameter estimates.

EMPIRICAL FINDINGS

Empirical findings on the multivariate analysis of HBP practice performance are presented in nine regression pairs for each of the dependent variables. The first regression in each pair contains predicted values of the endogenous variables representing HBP compensation methods; the second contains dummy variables representing actual compensation methods. The first regression in each pair merits more attention, but except for the compensation method variables, the regression pairs yield very similar results.

All regressions were estimated in semi-log form; that is, natural logarithms were taken of dependent variables and independent variables were entered linearly.[20] Coefficients thus indicate the percent change in the dependent variable resulting from a unit change in the independent variable. In the case of dummy variables, coefficients indicate the percent difference in the dependent variable between cases with and without the attribute signified by the dummy variable.

The regressions explain considerably more variation in net incomes and net incomes per hour of work than in gross incomes, deductions, or outputs per hour. The discussion of findings emphasizes net incomes and references other regression results where comparisons with the income regression results are particularly germane. Output regression results are discussed separately. Comparisons with other research findings on physician revenue determinants are also included. Emphasis is placed on the mutual interdependency of HBPs and hospitals. HBP departments are a source of revenue for hospitals as well as their HBPs, and there is a "division of the pie" phenomenon relevant to HBP income determination that warrants explicit recognition in discussion of the empirical findings.[21]

Means, standard deviations, concise definitions, and data sources pertaining to the dependent and independent variables are presented in Table 10-1. Regression results on net incomes are presented in Table 10-2, net incomes per hour of medical activity in Table 10-3, gross income and deductions in Table 10-4, and specialty-specific outputs per hour in Table 10-5. Logit regression results pertaining to the predicted compensation method probabilities are presented in Appendix F. The parameter estimates are discussed in terms of logically-ordered groupings of the independent variables.

MD Personal Characteristics

The MD personal characteristics variables (FEMALE, FMG, AGE60, and GRAD10) tend to perform as expected in the income regressions but have little consistent effect on deductions or output per hour. Holding other variables constant, female MDs and graduates of foreign medical schools tend to earn less than male MDs and U.S. medical school graduates, respectively, regardless of whether yearly or hourly net income is the dependent variable. Moreover, the effect of being female is slightly greater than the effect of being an FMG. In the net income regressions (Tables

Table 10-1 Variable Means, Standard Deviations, Concise Definitions, and Data Sources

Variable Name	*Mean*	*(s.d.)*	*Definition*	*Data Source*
NETY[a,b]	67,107	(29,493)	Net income (excludes deferred income)	(1)
TNET[a,b]	85,091	(35,034)	Total net income (includes deferred income)	(1)
NETYHR[a,b]	28.68	(14.88)	NETY per yearly hour of medical activity	(1)
TNETHR[a,b]	35.53	(17.58)	TNET per yearly hour of medical activity	(1)
GRSY[a,b]	117,484	(83,204)	Gross income	(1)

Table 10-1 Variable Means, Standard Deviations, Concise Definitions, and Data Sources

Variable Name	*Mean*	*(s.d.)*	*Definition*	*Data Source*
NETY[a,b]	67,107	(29,493)	Net income (excludes deferred income)	(1)
TNET[a,b]	85,091	(35,034)	Total net income (includes deferred income)	(1)
NETYHR[a,b]	28.68	(14.88)	NETY per yearly hour of medical activity	(1)
TNETHR[a,b]	35.53	(17.58)	TNET per yearly hour of medical activity	(1)
GRSY[a,b]	117,484	(83,204)	Gross income	(1)
DEDUC[a,b]	44,219	(52,697)	Practice deductions	(1)
LBHR[a]	76.36	(10.78)	Lab tests interpreted per hour (pathologists)	(1)
OPHR[a]	0.756	(0.427)	Operations and assists per hour (anesthesiologists)	(1)
XRHR[a]	11.58	(6.26)	X-rays interpreted per hour (radiologists)	(1)
FEMALE[c]	0.074	--	Denotes female MDs	(1)
FMG[c]	0.241	--	Denotes graduates of non-Canadian foreign medical schools	(2)
AGE60[c]	0.130	--	Denotes MDs age 60 or older	(2)
GRAD10[c]	0.090	--	Denotes MDs 10 years or less since medical school graduation	(2)
BOARD[c]	0.820	--	Denotes board certified MDs	(2)
CHIEF[c]	0.435	--	Denotes department chiefs	(1)
PERCAP[b]	6,258	(1,023)	County per capita income	(3)
OMDPOP	1.680	(1.049)	County non-federal office-based patient care MDs per 1000 population	(3)
HMDBED	0.015	(0.010)	County own-specialty HBPs per 1000 hospital beds	(3)
RATE[c]	0.144	--	Denotes states having mandatory hospital rate regulation authority	(4)
MCAID	0.111	(0.064)	Adjusted proportion of patients with Medicaid coverage	(1)
MCARE	0.225	(0.100)	Adjusted proportion of patients with Medicare coverage	(1)
PRVINS	0.563	(0.126)	Adjusted proportion of patients with private health insurance coverage	(1)
PTH[c]	0.347	--	Denotes pathologists	(1)
RAD[c]	0.322	--	Denotes radiologists	(1)
S2[c]	0.291	--	Denotes small nonsolo practices: $1 < S2 \le 4$	(1)
S3[c]	0.249	--	Denotes larger nonsolo practices: $4 < S3 < 10$	(1)
P2	0.151	(0.101)	Predicted probability of percentage compensation	(1)
P3	0.618	(0.226)	Predicted probability of fee-for-service compensation	(1)
R2[c]	0.138	--	Denotes HBPs having percentage compensation	(1)
R3[c]	0.588	--	Denotes HBPs having fee-for-service compensation	(1)
R4[c]	0.058	--	Denotes HBPs having other/unknown forms of compensation	(1)

Notes: a - dependent variables; b - monetary variables have been deflated by a cost of living index and expressed in 1977 dollars; c - binary (0,1) variables.

Data Sources: (1) HCFA-NORC Specialty Group B Surveys, 1977 & 1978; (2) American Medical Association Physician Masterfile, 1976 & 1977; (3) U.S. Bureau of Health Manpower, HHS, Area Resource File (1976); (4) Boeh, J.M. "Report on Budget/Rate Review Programs," Chicago, American Hospital Association (1979).

Table 10-2 Net Income Regressions

Variable	*NETY*				*TNET*			
	(1)		*(2)*		*(3)*		*(4)*	
FEMALE	-0.185^a	(0.054)	-0.172^a	(0.054)	-0.170^b	(0.066)	-0.164^b	(0.067)
FMG	-0.145^a	(0.036)	-0.192^a	(0.033)	-0.109^a	(0.040)	-0.156^a	(0.037)
AGE60	-0.127^a	(0.039)	-0.146^a	(0.039)	-0.058	(0.044)	-0.078^c	(0.044)
GRAD10	0.011	(0.047)	0.013	(0.047)	-0.009	(0.051)	-0.037	(0.051)
BOARD	0.071^c	(0.036)	0.068^c	(0.037)	0.102^b	(0.042)	0.107^b	(0.043)
CHIEF	0.062^b	(0.028)	0.070^b	(0.028)	0.021	(0.031)	0.026	(0.031)
PERCAP	0.051^a	(0.010)	0.055^a	(0.010)	0.060^a	(0.020)	0.062^a	(0.020)
OMDPOP	-0.021^c	(0.013)	-0.024^c	(0.013)	-0.017	(0.014)	-0.016	(0.014)
HMDBED	-5.832^a	(1.468)	-6.860^a	(1.457)	-7.561^a	(1.671)	-8.736^a	(1.647)
RATE	-0.139^a	(0.039)	-0.141^a	(0.039)	-0.032	(0.044)	-0.040	(0.044)
PMCAID	-0.712^a	(0.266)	-0.771^a	(0.268)	-0.686^b	(0.281)	-0.709^b	(0.284)
PMCARE	0.209	(0.197)	0.175	(0.199)	-0.229	(0.199)	0.219	(0.200)
PRVINS	-0.158	(0.174)	-0.226	(0.175)	-0.051	(0.177)	-0.083	(0.179)
PTH	-0.037	(0.055)	-0.023	(0.041)	-0.047	(0.063)	-0.028	(0.047)
RAD	-0.046	(0.040)	0.020	(0.033)	0.009	(0.046)	0.072^c	(0.037)
S2	0.193^a	(0.034)	0.165^a	(0.042)	0.149^a	(0.039)	0.126^a	(0.046)
S3	0.262^a	(0.034)	0.237^a	(0.039)	0.247^a	(0.037)	0.222^a	(0.042)
P2	0.812^a	(0.172)	--	(--)	0.830^a	(0.188)	--	(--)
P3	0.244^b	(0.101)	--	(--)	0.274^b	(0.118)	--	(--)
R2	--	(--)	0.112^c	(0.060)	--	(--)	0.160^b	(0.068)
R3	--	(--)	0.148^a	(0.045)	--	(--)	0.189^a	(0.054)
R4	--	(--)	0.166^b	(0.066)	--	(--)	0.241^a	(0.075)
Constant	10.574		10.786		10.644		10.803	
	$F(19,828) = 19.2^a$		$F(20,287) = 17.3^a$		$F(19,551) = 14.7^a$		$F(20,550) = 13.5^a$	
R^2(C)	0.290		0.278		0.314		0.305	

Notes: a = significant at the 1% level (two-tailed test),

b = significant at the 5% level (two-tailed test),

c = significant at the 10% level (two-tailed test).

Standard errors of the parameter estimates are in parentheses.

Table 10-3 Net Income per Hour Regressions

Variable	*NETYHR*				*TNETHR*			
	(5)		*(6)*		*(7)*		*(8)*	
FEMALE	-0.143^{b}	(0.069)	-0.130^{c}	(0.070)	-0.212^{b}	(0.089)	-0.211^{b}	(0.090)
FMG	-0.116^{b}	(0.049)	-0.162^{a}	(0.045)	-0.106^{c}	(0.055)	-0.154^{a}	(0.052)
AGE60	-0.032	(0.052)	-0.049	(0.052)	0.008	(0.058)	-0.004	(0.058)
GRAD10	0.063	(0.065)	0.046	(0.065)	0.070	(0.071)	0.040	(0.071)
BOARD	0.124^{b}	(0.052)	0.137^{b}	(0.053)	0.089	(0.062)	0.118^{c}	(0.065)
CHIEF	0.089^{b}	(0.037)	0.098^{a}	(0.037)	0.034	(0.041)	0.042	(0.042)
PERCAP	0.077^{a}	(0.020)	0.081^{a}	(0.020)	0.098^{a}	(0.020)	0.102^{a}	(0.020)
OMDPOP	-0.028	(0.018)	-0.034^{c}	(0.018)	-0.008	(0.022)	-0.016	(0.021)
HMDBED	-9.054^{a}	(1.960)	-10.084^{a}	(1.941)	-11.03^{a}	(2.288)	-12.29^{a}	(2.26)
RATE	-0.108^{b}	(0.053)	-0.113^{b}	(0.053)	0.039	(0.060)	0.026	(0.060)
PMCAID	-0.647^{c}	(0.353)	-0.703^{b}	(0.355)	-0.550	(0.379)	-0.628	(0.383)
PMCARE	0.191	(0.259)	0.174	(0.260)	0.019	(0.267)	0.043	(0.268)
PRVINS	-0.290	(0.226)	-0.333	(0.228)	-0.264	(0.236)	-0.286	(0.238)
PTH	0.103	(0.074)	0.099^{c}	(0.054)	0.109	(0.087)	0.128^{b}	(0.063)
RAD	0.008	(0.054)	0.061	(0.045)	0.074	(0.063)	0.145^{a}	(0.052)
S2	0.090^{b}	(0.046)	0.084	(0.056)	0.052	(0.052)	0.058	(0.062)
S3	0.184^{a}	(0.045)	0.179^{a}	(0.052)	0.197^{a}	(0.051)	0.188^{a}	(0.057)
P2	0.754^{a}	(0.232)	--	(--)	0.882^{a}	(0.256)	--	(--)
P3	0.239^{c}	(0.135)	--	(--)	0.269^{c}	(0.162)	--	(--)
R2	--	(--)	0.049	(0.078)	--	(--)	0.051	(0.090)
R3	--	(--)	0.101^{c}	(0.060)	--	(--)	0.152^{b}	(0.072)
R4	--	(--)	0.136	(0.089)	--	(--)	0.210^{b}	(0.101)
Constant	2.657		2.860		2.727		2.890	
	$F(19,686) = 10.5^{a}$		$F(20,685) = 9.4^{a}$		$F(19,453) = 8.8^{a}$		$F(20,452) = 8.0^{a}$	
$R^2(C)$	0.203		0.193		0.239		0.230	

Notes: a = significant at the 1% level (two-tailed test),

b = significant at the 5% level (two-tailed test),

c = significant at the 10% level (two-tailed test).

Standard errors of the parameter estimates are in parentheses.

Table 10-4 Gross Income and Deductions Regressions

Variable	*GRSY*				*DEDUC*			
	(9)		*(10)*		*(11)*		*(12)*	
FEMALE	-0.128^c	(0.073)	-0.107	(0.071)	-0.230	(0.285)	-0.322	(0.261)
FMG	-0.155^a	(0.051)	-0.199^a	(0.045)	0.018	(0.172)	-0.134	(0.147)
AGE60	-0.150^a	(0.056)	-0.182^a	(0.054)	0.201	(0.187)	0.098	(0.168)
GRAD10	0.094	(0.065)	0.083	(0.062)	0.163	(0.201)	0.226	(0.182)
BOARD	0.053	(0.052)	0.073	(0.051)	0.350^b	(0.173)	0.341^b	(0.162)
CHIEF	0.090^b	(0.039)	0.091^b	(0.038)	0.108	(0.127)	0.168	(0.117)
PERCAP	0.052^a	(0.020)	0.053^a	(0.020)	0.080	(0.070)	0.070	(0.060)
OMDPOP	-0.007	(0.018)	-0.004	(0.017)	0.048	(0.056)	0.049	(0.050)
HMDBED	-4.742^b	(2.051)	-5.541^a	(1.967)	-21.862^a	(7.266)	-19.818^a	(6.596)
RATE	-0.003	(0.056)	-0.010	(0.054)	0.258	(0.185)	0.179	(0.170)
PMCAID	-0.723^b	(0.359)	-0.748^b	(0.350)	0.068	(1.238)	0.120	(1.137)
PMCARE	-0.053	(0.266)	-0.077	(0.260)	0.170	(0.956)	0.075	(0.878)
PRVINS	-0.015	(0.232)	-0.079	(0.226)	0.437	(0.850)	0.334	(0.779)
PTH	-0.041	(0.079)	0.017	(0.056)	-0.568^b	(0.265)	-0.198	(0.176)
RAD	-0.027	(0.058)	0.069	(0.046)	0.200	(0.191)	0.364^b	(0.142)
S2	0.281^a	(0.049)	0.128^b	(0.060)	0.622^a	(0.163)	-0.113	(0.175)
S3	0.307^a	(0.047)	0.177^a	(0.053)	0.475^a	(0.160)	-0.080	(0.163)
P2	0.884^a	(0.240)	--	(--)	1.256	(0.803)	--	(--)
P3	0.409^a	(0.142)	--	(--)	1.015^b	(0.480)	--	(--)
R2	--	(--)	0.421^a	(0.080)	--	(--)	2.103^a	(0.249)
R3	--	(--)	0.437^a	(0.060)	--	(--)	1.769^a	(0.192)
R4	--	(--)	0.523^a	(0.090)	--	(--)	1.520^a	(0.270)
Constant	10.798		10.906		7.963		7.611	
	$F(19,822) = 12.7^a$		$F(20,821) = 14.7^a$		$F(19,460) = 5.3^a$		$F(20,459) = 10.3^a$	
R^2(C)	0.209		0.248		0.145		0.280	

Notes: a = significant at the 1% level (two-tailed test),
b = significant at the 5% level (two-tailed test),
c = significant at the 10% level (two-tailed test).
Standard errors of the parameter estimates are in parentheses.

Table 10-5 Output per Hour Regressions

Variable	*LBHR*		*OPHR*		*XRHR*	
	(13)	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*
FEMALE	-0.100	-0.138	0.147[c]	0.090	-0.195	-0.180
	(0.188)	(0.178)	(0.086)	(0.088)	(0.208)	(0.210)
FMG	-0.018	-0.040	-0.010	0.066	0.086	-0.051
	(0.119)	(0.108)	(0.058)	(0.054)	(0.139)	(0.104)

Table 10-5 Output per Hour Regressions

Variable	*LBHR*		*OPHR*		*XRHR*	
	(13)	*(14)*	*(15)*	*(16)*	*(17)*	*(18)*
FEMALE	-0.100	-0.138	0.147[c]	0.090	-0.195	-0.180
	(0.188)	(0.178)	(0.086)	(0.088)	(0.208)	(0.210)
FMG	-0.018	-0.040	-0.010	0.066	0.086	-0.051
	(0.119)	(0.108)	(0.058)	(0.054)	(0.139)	(0.104)
AGE60	0.374[b]	0.254[c]	-0.140[c]	-0.135[c]	-0.027	-0.078
	(0.160)	(0.134)	(0.073)	(0.074)	(0.101)	(0.098)
GRAD10	0.010	-0.004	-0.000	0.006	0.270[b]	0.207[b]
	(0.207)	(0.201)	(0.104)	(0.105)	(0.106)	(0.091)
BOARD	-0.137	-0.115	0.106[c]	0.090	-0.061	-0.105
	(0.173)	(0.157)	(0.057)	(0.058)	(0.097)	(0.096)
CHIEF	0.119	0.157	0.114[b]	0.115[b]	-0.041	-0.016
	(0.100)	(0.100)	(0.054)	(0.054)	(0.066)	(0.066)
PERCAP	0.055	0.024	0.033	0.034	-0.063[c]	-0.077[a]
	(0.060)	(0.050)	(0.030)	(0.030)	(0.030)	(0.030)
OMDPOP	-0.003	-0.045	-0.008	-0.003	-0.000	-0.016
	(0.071)	(0.062)	(0.021)	(0.021)	(0.033)	(0.031)
HMDBED	-13.677[b]	-12.850[b]	-8.917[a]	-7.994[a]	2.116	1.039
	(6.212)	(6.086)	(3.106)	(2.910)	(3.971)	(3.811)
RATE	-0.040	-0.017	-0.087	-0.094	-0.054	-0.062
	(0.147)	(0.144)	(0.078)	(0.079)	(0.087)	(0.087)
PMCAID	1.598	1.014	0.436	0.666	-1.617[b]	-1.558[b]
	(1.309)	(1.179)	(0.614)	(0.626)	(0.635)	(0.647)
PMCARE	1.122	1.240	-0.321	-0.154	-0.258	-0.249
	(0.778)	(0.760)	(0.468)	(0.475)	(0.516)	(0.519)
PRVINS	0.243	0.632	0.025	0.302	-0.170	-0.225
	(0.691)	(0.647)	(0.436)	(0.440)	(0.453)	(0.458)
S2	0.156	0.392[b]	0.150[b]	0.198[a]	-0.222[a]	-0.231[b]
	(0.111)	(0.180)	(0.071)	(0.076)	(0.084)	(0.107)
S3	0.020	0.319	0.029	0.074	-0.269[a]	-0.270[a]
	(0.147)	(0.202)	(0.059)	(0.064)	(0.080)	(0.099)
P2	0.969	--	-0.765	--	0.954[b]	--
	(0.726)	(--)	(0.748)	(--)	(0.421)	(--)
P3	-0.391	--	-0.790[a]	--	0.421	--
	(0.395)	(--)	(0.192)	(--)	(0.386)	(--)
R2	--	-0.083	--	-0.351[a]	--	-0.012
	(--)	(0.220)	(--)	(0.129)	(--)	(0.147)
R3	--	-0.410[b]	--	-0.198[b]	--	0.029
	(--)	(0.183)	(--)	(0.081)	(--)	(0.127)
R4	--	-0.313	--	-0.236[b]	--	-0.210
	(--)	(0.233)	(--)	(0.117)	(--)	(0.168)
Constant	1.816	1.946	0.146	-0.642	2.779	3.458
	F(17,128) = 1.5[c]	F(18,127) = 1.9[b]	F(17,251) = 2.9[a]	F(18,250) = 2.2[a]	F(17,231) = 2.6[a]	F(18,230)= 2.3[a]
R^2(C)	0.056	0.097	0.107	0.076	0.098	0.084

Notes: a = significant at the 1% level (two-tailed test),

b = significant at the 5% level (two-tailed test),

c = significant at the 10% level (two-tailed test).

Standard errors of the parameter estimates are in parentheses.

10-2 and 10-3), FEMALE parameter estimates indicate net earnings ranging from 16 to 21 percent lower for female MDs than male MDs and FMG parameter estimates indicate net earnings ranging from 11 to 19 percent lower for FMGs than U.S. medical school graduates.

Unadjusted net income and gross incomes of older MDs are on the order of 15 percent lower than younger MDs, as indicated by parameter estimates on AGE60 in regressions (1), (2), (9), and (10), but the effects of old age are diminished when deferred income and hours of work are taken into account. In the adjusted net income per hour of medical activity regressions [nos. (7) and (8)], the effect of AGE60 is essentially nil. The variable GRAD10 indicating recent medical school gradautes is positive in most of the income regressions but never attains significance at the five percent level. Apparently, the effects of medical education vintage and recent entry into the practice of medicine are largely offsetting.

These results are consistent with research on office-based MDs by Sloan (1975) and Kehrer (1976) which provide MD income estimating equations based on cross-sectional data. Both of these studies find that females have lower net earnings than males, in part (but not entirely) due to shorter working hours of female MDs. Both studies also found that FMGs tend to earn less, _ceteris paribus_, than U.S. medical school graduates. However, the estimates for HBPs tend to indicate larger partial effects of FMG status in the present study than in the Sloan and Kehrer studies.[22] Age-related variables were less comparable between the Sloan and Kehrer studies and the present one. The Sloan specification contained a series of age-related dummy variables indicating that office-based MDs over age 60 tended to earn substantially less per week and per hour while the results for younger MDs (age 30-39) were inconclusive. Kehrer entered experience (years in practice) and the square of experience as independent variables. The negative sign of the squared term is consistent with the present results on AGE60.

MD Professional Characteristics

Professional characteristics are represented in the regressions by the variables BOARD, CHIEF, S2, S3, PTH, and RAD. Board certified HBPs and department chiefs tend to earn consistently more than non-certified, non-chief HBPs, all other things being equal. The partial effects are more pronounced for board certification; moreover, these effects tend to increase when hours of work and deferred income are taken into account while the opposite is true for department chiefs. Results on BOARD are consistent with those of Kehrer (1976), who found a slightly greater effect of board certification on hourly earnings of male office-based MDs.

The regressions indicate a substantial effect of practice size on HBP earnings. Holding other factors constant, HBPs in small groups (2-4 MDs) tend to earn considerably more than solo HBPs, and HBPs in larger groups (5-10 MDs) tend to earn the most. The effect of practice size is greatest on unadjusted yearly net incomes and least on adjusted net incomes per hour--when net incomes are expressed on a per hour basis [regressions (5) through (8)], the effect of small group membership is reduced considerably but the effect of larger group membership is still substantial, nearly 20 percent higher incomes per hour than solo HBP practice. In the gross income and deductions regressions [nos. (9) through (12)], the group size dummy variables are highly collinear with the reimbursement type variables in equations (10) and (12), but equations (9) and (11) indicate considerable effects of non-solo practice on gross incomes and deductions per HBP. In the latter instance, parameter estimates on S2 and S3 indicate, respectively, deductions 62 percent and 48 percent higher than solo HBPs.

These results are similar to those of Evans, Parish, and Sully (1973) except that they found the effect of the larger group size to be only about one-half that of the smaller group size. However, on examining associations between specialty composition and earnings by group size, Evans, Parish, and Sully concluded that income gains to larger group membership were probably considerably greater for HBPs than office-based MDs.

Parameter estimates on the specialty dummy variables, PTH and RAD, show an inconsistent pattern. These estimates are positive in the earnings per hour regressions but seldom attain statistical significance. Based on bivariate distributions of HBP incomes per year and per hour from the same data source, one might have expected more pronounced differences between anesthesiologists and the other two specialties (represented by PTH and RAD in the regressions).[23] The regression results indicate that these differences tend to dissipate when other factors are held constant.

Characteristics of the physician's market are represented by the variables PERCAP, OMDPOP, HMDBED, and RATE. The regressions indicate a positive and consistent impact of per capita income on HBP incomes. Elasticities of PERCAP range from +.32 in the first NETY regression to +.65 in the second $\overline{\text{T}}$NETHR regression. These findings correspond to those of past research by Benham, Maurizi, and Reder (1968), Sloan (1975), Kehrer (1976), and Brown, Benham, and Benham (1976). In regressions on incomes of office-based MDs presented in these studies, elasticities of per capita income ranged from +.21 to +.50.

All of the signs of OMDPOP coefficients are negative, but seldom attain statistical significance at conventional levels. From these results we may conclude that despite the fact that HBPs receive nearly all of their patients on referral from office-based MDs, the services of office-based and hospital-based MDs cannot be regarded as complements. In contrast, the variable HMDBED has a consistently statistically significant impact on HBP incomes. As predicted, the effect of local HBPs per hospital bed was negative in the income regressions. Elasticities of this variable are not large, however; they range from -.10 in the first NETY regression [no. (1)] to -.20 in the second TNETHR regression [no. (8)].

Because of the way the physician supply variables were constructed, these results are not strictly comparable to those of past research. In studies of office-based MDs' incomes by Sloan (1968), Benham, Maurizi, and Reder (1968), Sloan (1975), Kehrer (1976), and Brown, Benham, and Benham (1976), elasticities on physician supply variables ranged from -.09 to -.60. The present results indicate that HBP income response to physician supply is at the low end of this range.[24]

The dummy variable RATE, denoting states with hospital rate regulation authorities, was included to capture effects of a strict regulatory climate and specific practices limiting hospital-HBP arrangements. Results on this variable in the income regressions are curious--RATE has a significantly negative effect in the NETY and NETYHR regressions, indicating that HBPs in states where RATE equals 1 earn 11 to 14 percent less than HBPs in other states, but this effect falls to zero when deferred income is taken into account (in TNET and TNETHR regressions). These results imply that the main effect of hospital rate regulation agencies (or a strict regulatory climate) on HBP behavior is to cause them to defer a relatively high proportion of their incomes. Specific reasons why this happens are unknown.

The effect of insurance is captured by the patient coverage proportion variables MCAID, MCARE, and PVINS, with proportion uninsured held constant in the regressions. The Medicaid variable is consistently negative and usually statistically significant in the income regressions. The Medicare variable tends to have positive signs and the private insurance variable, surprisingly, tends to have negative signs in the income regressions. Neither of these variables, however, attains statistical significance in the income regressions. The results on MCARE and especially PVINS are clearly contrary to expectations. The MCAID results are certainly plausible; even though the negative coefficients of MCAID are with reference to patients without health insurance coverage, Medicaid program constraints on fees charged to Medicaid patients are capable of having a negative impact on physician incomes. The mean of MCAID in this sample of HBPs is approximately 0.11. The regression results imply that an increase of one percentage point to 0.12 would decrease HBP net incomes, on average, by over $4,000.

Other studies that have included insurance variables in physician income equations have found a substantial positive effect of insurance. In Sloan (1968) and Brown, Benham, and Benham (1976), the elasticity of a variable representing percent of area population having health insurance was +.53 and +.44, respectively. Differences between these earlier studies and the present study in the way insurance variables were defined no doubt account for part of the dissimilarity in results. Part of the dissimilarity, however, is probably due to the differences between office-based and hospital-based practice. Regression results on the insurance variables generally indicate that lack of insurance coverage does not constrain HBP incomes.[25]

The final independent variables indicate HBP compensation methods, with salaried compensation held constant. Odd-numbered regressions contain variables representing predicted probabilities of compensation by percentage of department revenue (P2) or fee-for-service (P3). Even-numbered regressions contain dummy variables indicating actual compensation method--percentage of department revenue (R2), fee-for-service (R3), or other/unknown methods (R4). Because compensation method is specified as endogenous to HBP income and other performance variables, the odd-numbered regression results merit more confidence.

As expected, all of the included P and R variables have positive signs and most are statistically significant. These results indicate that even when a number of factors are held constant, salaried HBPs earn considerably less than their colleagues who are paid on a piece-work basis. The even-numbered regressions indicate that the positive impact of R2 and R3 is less when income is expressed on a per hour basis (suggesting that part of the lower incomes of salaried HBPs is due to fewer hours of work), but this tendency is not reflected in the coefficients of P variables in the odd-numbered regressions.

The magnitudes of the P variable coefficients are far greater than corresponding magnitudes of the R variable coefficients. The latter tend to follow approximately the simple bivariate differences in average incomes among the three compensation methods. In contrast, coefficients of P2 indicating probability of percentage compensation are large; for example, a change from zero to 100 percent probability of percentage compensation implies an increase in net income per year or per hour of over 80 percent in most regressions. The effect of (predicted) fee-for-service compensation is less than one-third this large.

Two past studies included variables indicating physician employment (equivalent to salaried compensation in the present specification) in income equations. Kehrer (1976) found that employment had a thirteen percent decrease in net income per hour of male office-based MDs. Sloan (1975) defined his employment variables somewhat differently, but also found that employment, in reference to non-employed solo practice, had a substantial negative impact on weekly and hourly earnings of office-based MDs. Both Kehrer's and Sloan's results are roughly consistent with R variable results in the present analysis.

Output Regressions

Output regressions are less precise than the income regressions. This is due to two factors: first, HBP outputs are not well-measured. A major source of ambiguity is that physicians in HBP specialties do not always personally perform procedures but instead supervise technicians. This is especially true for pathology and least true for anesthesiology. Respondents were probably inconsistent with regard to the extent of technician-performed procedures recorded in the output measures. In any case, coefficients of variation were very large for the output measures, requiring extensive screening to remove extreme values.[26] Second, the outputs are heterogeneous; some practices may tend to perform more complex procedures than others, but the measures do not capture variations of this sort.

The output measures are specialty-specific--LBHR [regressions (13) and (14)] refers to pathologists, OPHR [regressions (15) and (16)] refers to anesthesiologists, and XRHR [regressions (17) and (18)] refers to radiologists. Therefore, there are fewer cases in each of these regressions than in the income regressions and the specialty dummy variables, PTH and RAD, are excluded.

The physician personal characteristics variables (FEMALE, FMG, AGE60, and GRAD10) reveal no consistent pattern in the output regressions. Signs of these variables tend to be unstable across specialties and seldom attain statistical significance. These results stand in sharp contrast to the income regressions where these variables (except for GRAD10) tended to exert substantial influence. Similarly, among the professional characteristics variables (BOARD, CHIEF, S2, and S3) the variables representing board certification and department leadership also show no consistent influence on output per hour. The practice size variables, however, reveal some consistency within specialties. For pathologists and anesthesiologists, the small group size (2-4 MDs) appears most productive. In regression (14) the coefficient of S2 implies that output per hour of small groups of pathologists is nearly 40 percent higher than that of solo pathologists, holding other factors constant. Coefficients of S2 and S3, however, are negative and statistically significant in the X-rays per hour regressions and about the same order of magnitude between small and larger groups. These coefficients imply that, holding other factors constant, solo radiologists are approximately 25 percent more productive than non-solo. There is no clear reason why practice size effects should be so different between radiologists and the other HBP specialties. It is possible that these results are an artifact of an association between size and procedure complexity that differ among the HBP specialties.

Of the market characteristics variables, HMDBED has the most substantial effect on HBP output per hour, but only for pathologists and anesthesiologists. Elasticities of HMDBED are as much as -.20 in the LBHR regressions and as much as -.15 in the OPHR regressions. The effect of this variable is essentailly nil in the X-rays per hour regression. Of the four market characteristics variables, only per capita income, with negative impact and elasticities in the -.40 to -.51 range, attains statistical significance in the X-rays per hour regression. The negative signs on HMDBED and PERCAP are plausible. A greater supply of HBPs in a specialty may cause individual HBPs to spread work over a longer period, which is certainly consistent with negative signs of this variable in the income regressions. Negative signs on PERCAP in the XRHR regression suggest a product modification (i.e., more MD time provided per procedure) in treating affluent patients. This is consistent with positive effects of PERCAP in the income regressions only if expanded physician time is accompanied by higher prices.

Signs of the compensation method variables, P2, P3, R2, R3, and R4 are inconsistent across specialty. Ex ante, one might expect all signs to be positive. Salaried HBPs, the reference category in the output regressions, have no short run financial incentive to expand output per MD hour while revenues of percentage and fee-for-service HBPs should be positively associated with output per HBP hour. However, we observe more negative signs of the piecework compensation method variables, both predicted and actual, than positive. These results are consistent with those of Hellinger (1979), who in his study of hospital radiology and pathology departments also found no negative effects of salaried compensation on output.[27] On the whole, based on these results, we cannot accept the hypothesis that piecework (percentage or fee-for-service) HBP compensation systematically leads to higher rates of productivity than salaried HBP compensation.

SUMMARY AND IMPLICATIONS

As of year end 1977, there were approximately 40 thousand patient-care HBPs in anesthesiology, pathology, and radiology practicing in the U.S., about 12.6 percent of all patient-care physicians (Gaffney and Glandon, 1979). Based on gross income figures from the HCFA-NORC Surveys, payments to these physicians exceeded $4 billion in 1977. Clearly, marginal impacts on HBP incomes from changes in the market for HBP services are capable of having a substantial influence on aggregate consumer health service expenditures. This important segment of the physicians' services market has been neglected by researchers for far too long.

The analysis presented in this paper has attempted to identify and assess the importance of factors accounting for variations in HBP incomes, deductions, and outputs. Emphasis has been placed on explaining variation in net HBP incomes and on examining the role of HBP compensation methods in HBP income determination. Two variants of all regressions have been presented--one which treats HBP compensation as exogenous and the other which treats HBP compensation as endogenous in systems determining HBP economic performance. It is important to recognize that the HBP compensation method is a product of joint HBP-hospital decision making or negotiation. HBPs that insist on one method or another must be able to find hospitals willing to accept the preferred method under terms mutually acceptable to HBPs and the hospital. The relative strengths of HBPs and hospitals in this bargaining process are likely determinants of the distribution of compensation arrangements. These arguments imply that perhaps more information on the HBP's hospital (or hospitals) would have been desirable in a model to explain compensation method selection and HBP incomes. However, such information would clearly be endogenous because hospital selection itself is likely to be influenced by the same factors that determine compensation methods and incomes.

The empirical analysis found that HBP personal characteristics, especially sex and foreign origin, are important determinants of HBP incomes. Comparisons with past research findings indicate that the influence of these factors is greater on HBP incomes than on incomes of office-based MDs. HBP specialties may attract females and FMGs who are less able to function in independent practice than office-based females and FMGs, which might account for their relatively low remuneration in HBP settings. This is a bit conjectural, however. Output regression results indicate that the lower incomes of females and FMGs cannot be ascribed to lower productivity. By implication, an increase in the proportion of females and FMGs in HBP specialties may serve to reduce aggregate expenditures for ancillary services.

Among physicians' professional characteristics, board certification and department chiefdom have modest positive effects on HBP earnings, but the greatest effects are due to nonsolo practice arrangements.[28] The positive effects of nonsolo practice are not universally reflected in the output per HBP hour regressions although, on the whole, the effects are slightly positive.[29] The output regressions, however, account for only a limited proportion of HBP production, and service mix is not held constant. A possibility that should be considered is that nonsolo HBPs have more power than solo MDs in bargaining with hospitals, and therefore, all other things being equal, they obtain a larger share of the total revenue generated by their departments.

It is interesting that the interspecialty differences in HBP incomes are substantially reduced in the income regressions. For example, net income figures reported in Steinwald (1980) indicate that pathologists and radiologists, respectively, earned 2 percent and 15 percent more than anesthesiologists in 1976-1977. The corresponding parameter estimates presented in regression (1), however, imply that both radiologists and pathologists earn less than anesthesiologists when all other factors are held constant.[30] An examination of sample means of independent variables by specialty reveal some of the reasons underlying the discrepancy between income averages by specialty and regression results. Anesthesiologists have a higher proportion of females, FMGs, and solo practitioners than the other two HBP specialties. When the partial effects of these variables are taken into account, "pure" income differences between the HBP specialties are reduced. These factors are unlikely to account for income differences between HBPs and office-based MDs, however. Office-based MDs do not have systematically higher proportions of females, FMGs, and solo practitioners than hospital-based MDs.

Among characteristics of the HBP's market, per capita income has the most consistent and substantial effect on HBP incomes, with elasticities in the +.32 to +.65 range. In fact, contrary to some research on office-based MDs, the effect of per capita income is greater than that of insurance coverage. In past research on office-based physicians that has included both insurance and per capita income in MD income specifications, insurance has had the greater effect. In the present specification amount of insurance coverage has virtually no effect on HBP incomes. The only consistent effect among the insurance variables is a negative impact of Medicaid coverage which is due to the constraints placed on Medicaid payments to physicians.[31] These findings suggest that, relative to office-based MDs, extent of insurance coverage is not nearly as important as patient innate ability to pay in influencing HBPs incomes. Because coverage for ancillary services is typically subject to deductible and copayment provisions, coverage distributions tend to overstate the percent of the marginal dollar of HBP charges paid for by the insurer. In cases where the patient pays for the service out of pocket, ability to pay (as represented by per capita income) has considerable importance.

The relative supply of physicians in the same specialty exerts a consistently negative effect on HBP incomes, as was found in past studies of office-based MDs. The effect on HBPs, however, while consistent, is not large. Partial elasticities of HBP supply with respect to HBP incomes are as low as -.05 in some specifications and never exceed -.20.[32] Most studies of office-based MDs have found MD incomes to be more sensitive to physician supply.[33] Moreover, despite the fact that most HBPs' patients are referred by office-based MDs, we do not find a positive association between the supply of office-based MDs and incomes of HBPs. Instead, we find that the supply of HBPs relative to population is highly correlated with the supply of office-based MDs relative to population.[34]

The presence of state rate-regulation agencies appears to have an influence on HBP economic behavior, although the precise nature of this effect cannot be determined with the evidence at hand. Parameter estimates from the income regressions suggest that the main effect of the presence of such agencies is to cause HBPs to defer a relatively large proportion of their incomes. We cannot tell whether (1) specific activities of such agencies cause this behavior; or (2) a propensity for HBPs to defer income and the existence of state hospital rate regulatory agencies are both correlated with a third, unmeasured variable (such as a strict regulatory climate). The safest conclusion to draw from these results is that hospital rate regulation programs may have side effects on physician behavior and such effects are worthy of investigation in future research.

Regression results on the predicted and actual compensation method variables present an unexpected pattern. One expects the actual compensation method variables to have higher (in absolute value) coefficients than the predicted variables because the latter "purge" the association between compensation method and the dependent variables from simultaneous effects of "income-loving" physicians seeking high-income compensation systems. However, the predicted variable coefficients are larger than the actual. A plausible explanation for this is the presence of errors in the reimbursement type variables; that is, due to ambiguity in the survey instrument or data transcription errors, some physicians' compensation methods were mistakenly recorded. In any case, these results, combined with the poor performance of the logit reimbursement type regressions, do not inspire much confidence.

The regression results do confirm descriptive evidence that percentage and fee-for-service compensation of HBPs are considerably more lucrative than salaried compensation. Results in the regressions with compensation probabilities entered as independent variables tend to support policy developments that are unfavoarble to percentage compensation systems. These include Medicare-Medicaid reform measures such as the Talmadge proposal (95th Congress, S. 1470) and the several other hospital cost containment proposals. The more recent attempt to strengthen Medicare's principles of reimbursement regarding separation of billings for professional and nonprofessional services (Federal Register, March 1980) does not have this effect.[35] The regression results indicate that percentage-compensated HBPs, when other factors are taken into account, earn substantially more than fee-for-service HBPs as well as salaried HBPs. These results imply that savings may be realized by policies that cause HBPs to switch from percentage to fee-for-service compensation.

Few of the income and expense regression results were replicated in the output per hour regressions, leading to the general conclusion that variations in HBP incomes are not largely determined by variations in productivity. An exception is the specialty-specific HBPs per county hospital bed variable--for pathologists and anesthesiologists, a relatively large supply of HBPs leads to reductions in both productivity and income. Also, for these two specialties, nonsolo practice arrangements are associated with both higher productivity and income. Last, most of the coefficients signifying non-salaried compensation arrangements are negative in the output regressions. This contradicts conventional wisdom regarding incentives in salaried versus piecework compensation systems but is consistent with the findings of past research in this area.

The empirical results presented in this paper illuminate some of the factors underlying variations in HBP incomes, but it must be conceded that the economics of medical practice in HBP specialties are still only dimly understood. We find that HBP incomes are responsive to variations in personal and professional characteristics and to variations in area market characteristics. Most of these results were consistent with research findings pertaining to office-based MDs. However, the empirical specifications were unable to detect sources of much of the variation in choice of compensation method, deductions, or output per HBP hour. A more thorough examination of these factors would require information on both HBPs and on hospitals and a model that jointly considers decision-making and behavior of HBPs and hospitals.

FOOTNOTES TO CHAPTER 10

[1] Evidence that expenditures for HBP-delivered services are increasing at a faster pace than health services generally is provided by Scitovsky (1977), Scitovsky and McCall (1977), and Redisch (1978). Recent evidence on HBP incomes and structural features of this market are provided by Arthur Andersen & Co. (1977), Gabel and Redisch (1978), Hellinger (1979), and Steinwald (1980). For a discussion of legal issues, see Thompson (1979) and Calvani and James (1980).

[2] See, for example, Somers and Somers (1967), Van Dyke, *et al*. (1968), Begole *et al*. (1972), Blakely (1973), *Modern Healthcare* (1974), Arthur Andersen & Co. (1977), and Steinwald (1980).

[3] Steinwald (1980) has suggested that the procedures for reimbursement of hospital-based physicians' services established for the Medicare and Medicaid programs are a major cause of the movement away from percentage compensation of HBPs. This movement is also consistent with current policy initiatives which, for a variety of reasons, view percentage compensation of HBPs contrary to the public interest. These views are implicit, for example, in Senator Talmadge's proposal for reform of Medicare and Medicaid reimbursement (95th Congress, S. 1470) and in the Carter administration's Hospital Cost Containment proposal.

[4] Sample strata were defined on the basis of physician specialty and location. Survey data files provided by HCFA contain weight factors for each physician record which approximate the number of physicians in the U.S. that each sample member represents. Statistics based on weighted cases thus have the appearance of the universe of sample-eligible physicians in the U.S. In this paper's empirical work, the weights are adjusted so that the numbers of weighted and unweighted cases are identical.

[5] Recent theoretical contributions by economists have been provided by Sloan (1968), Feldstein (1970), Newhouse (1970), Fuchs and Kramer (1972), Evans (1974), Sloan and Feldman (1978), and Reinhardt (1978). Controversies remain on the degree to which the physicians' services market is monopolistic or competitive and on the extent to which structural features of the market (including entry conditions) inhibit competitive behavior and outcomes.

[6] According to American Medical Association data presented in Gaffney and Glandon (1979), about 9.1 percent of office-based patient care MDs were salaried at year end 1977 while the corresponding percentages for anesthesiologists, pathologists, and radiologists were 14.4, 30.4, and 19.1, respectively.

[7] This observation is based on preliminary data from a survey conducted in late 1979 by the American Hospital Association. The survey was financed by Grant number 95-P-9717613 from the Health Care Financing Administration to the Urban Institute, with a subcontract to Vanderbilt University.

[9] See Schmidt and Strauss (1975) for a description of logit and Sloan (1978) for a health field application.

[10] Net and gross incomes were reported in groups and were recoded to the midpoint of each group. Respondents falling into the highest income category ($100,000 or more for net income) were asked to report actual (non-grouped) income. For those indicating the highest income cateogry who did not report actual income, the mean of reporting physicians in this income cateogry was substituted.

[11] For most analytic purposes, economists would be indifferent about the division of total net income between deferred and undeferred. To exclude deferred income entirely may seriously underestimate net income, however.

[12] In addition, deductions estimates are considerably higher than estimates of anesthesiologists and radiologists expenses reported by the American Medical Association in Gaffney and Glandon (1979). It is possible that physicians regard "deductions" as a more all-inclusive measure than "expenses" when responding to surveys. See Appendix A.

[13] The cost of living index is constructed from U.S. Department of Labor (1975). A full description of index construction can be found in Sloan and Steinwald (1980).

[14] Two factor price variables representing area indexes of wages paid to office employees and rental expenses were entered in preliminary specifications without contributing significantly to explaining variation in physician incomes, expenses, or outputs. These variables were excluded from final regression specifications.

[15] Statistics presented in Steinwald (1980) indicate that while this ordering is consistent over all income measures, net income per hour is nearly as high for pathologists as radiologists while the latter specialty is much higher than the other two HBP groups in net income per year. In addition, because hours pertain to hours of medical activity, excluding practice management time (which tends to be twice as high in pathology as in the other two specialties) per hour income figures for pathologists may be slightly overstated relative to the other two specialties.

[16] Like all monetary dependent variables, PERCAP is deflated by an area cost of living index to correct for interarea variations in price levels.

[17] According to a survey conducted by the American Hospital Association (Boeh, 1979), state-created agencies empowered to regulate hospital rates existed in eight states in 1979.

[18] Maryland is one state having an explicit policy to limit the degree of cross-subsidization permissible in hospital rate structures (Cohen, 1978).

[20] This approach follows a tradition established by Mincer (1974) in estimating earnings functions and has had wide applications (e.g., Lillard and Willis, 1978; Griliches, 1961). See Goldman and Grossman (1978) for a health field application.

[21] Pauly and Redisch (1973) and Harris (1977), among others, have emphasized the joint decision-making characteristics of hospitals and physicians with reference to mainstream medical care. Given the structural characteristics of hospital-based practice, it seems intuitively likely that such considerations would apply to an even greater extent in the case of HBPs.

[22] Sloan included two FMG variables in his specification, one indicating FMGs from English-speaking and/or Western European countries, the other indicating FMGs from non-English sepaking, non-Western European countries. Only the latter variable was statistically significant in his regressions. The Kehrer FMG variable is defined as in this study, but (for male MDs) the partial effect of FMG status was only about half that of the present study.

[23] Steinwald (1980) presents evidence indicating that in 1976-77 anesthesiologists earned, on average, $63,810 per year and $28.41 per hour; pathologists earned $65,004 per year and $35.83 per hour; and radiologists earned $73,322 per year and $37.55 per hour.

[24] In an alternative regression specification containing a variable representing specialty-specific HBPs per unit of population, elasticities of this variable were near -.10 in all income regressions.

[25] Values of the insurance variables depend upon survey respondents' abilities to identify coverage distributions of their patients. The frequency of missing values (which were filled in by averages by specialty and geographic location) and implausible values indicate imprecision in these estimates.

[26] Screens were established so that minimum and maximum values of the output measures differed by a factor of ten, centered on the means of the output measures.

[27] Hellinger's regression specification included casemix variables to capture relationships between department output and compensation method. He also found, however, that the piecework compensation systems were associated with higher prices than salaried systems, which, in the present study, would be sufficient to account for the discrepancy between parameter estimates on compensation method variables in the income and output per hour regressions. Markel and Mitchell (1980) found that method of pathologist compensation had no effect on either charges for or use of pathology services in a sample of Michigan hospitals. However, this study did not control for other factors that might also account for variations in charges and use rates.

[28] Because employed HBPs were considered solo practitioners (they do not share income or expenses with other HBPs), one might argue that the parameter estimates on non-solo practice arrangement variables (S2 and S3) included proxy effects of salaried employment. In fact, there is a modest amount of collinearity between the practice size and reimbursement method variables, but not enough to account for the magnitude of the practice size variable coefficients actually obtained.

[29] Effects of nonsolo practice on output per hour were positive for pathologists and anesthesiologists but negative for radiologists. See Table 10-5.

[30] These estimates are not statistically significant, however.

[31] Physicians have the option of refusing to treat Medicaid patients and thus those whose usual fees are relatively low may be more willing to treat Medicaid patients. However, very few HBPs in the sample indicated an explicit policy of refusing Medicaid patients, but several treat very few Medicaid patients.

[32] Coefficients shown in the tables pertain to HBPs per hospital bed. Alternative specifications with HBPs per unit of population (not shown) yield elasticities about one-half that of the HMDBED variable.

[33] An exception is Kehrer (1976) who found elasticities of about the same magnitude as the present study's.

[34] The sample correlation between office-based MDs per unit of population and HBPs per unit of population is +.79. In a preliminary specification a variable measuring the ratio of hospital-based to office-based MDs was entered in the income regressions without significant results.

[35] The Federal Register notice did not indicate a change in Medicare reimbursement principles but an intent to enforce regulations that were published in 1966. Enforcement of the regulation has the effect of preventing services not performed in person by an HBP (for example, most clinical pathology services) from being charged to Part B of Medicare, the Supplemental Medical Insurance fund created to pay for physicians' services on a "reasonable charge" basis. If this rule were fully implemented, it would probably result in less independent MD billing of patients for HBP services and concomitantly more hospital billing. HBPs would then receive payment from hospitals for these services which might be handled more easily under a percentage than a fee-for-service arrangement. However, a temporary injunction has been issued and these regulations are unlikely to be implemented in the near future.

SECTION VI

THEORETICAL MODELS OF PHYSICIAN BEHAVIOR

Chapter 11

The Market for Physicians' Services: Theoretical Implications and an Empirical Test of the Target Income Hypothesis

George Sweeney

INTRODUCTION

Over the period 1965 to 1977, expenditure upon health care in the United States increased from \$181 per capita to \$697 per capita.[1] The share of GNP composed of health care expenditures grew from 5.9% in 1965 to 8.8% in 1977. Over this same period, the number of physicians in the U.S. increased from 153 physicians per 100,000 population to 194 physicians per 100,000. Such startling figures have generated much interest in the economics of health care, with special concern about physician behavior and its effects upon health care costs.

The frequent empirical finding of a positive partial correlation between physicians' fees or earnings and the number of physicians per capita have led many observers to eschew standard supply and demand models in favor of models which allow physicians themselves to significantly affect the demand for their services.

An assumption that physicians influence demand can not by itself differentiate a model from standard microeconomic models. A profit maximizing doctor possessing (costless) demand shifting powers would shift demand to the greatest possible extent, and then choose price and quantity to maximize profits subject to that shifted demand function. Thus a demand shifting model can yield results which are qualitatively different from those predicted by a standard model only with a behavioral assumption other than profit maximization. The assumption of satisficing behavior on the part of physicians is a common substitute.

Numerous empirical findings have been cited as evidence of the validity of the satisficing-with-demand-shifting models. Much of this evidence, however, has been obtained as a by-product of estimates of the demand for physician services, rather than as the result of the estimation of a supply-induced-demand-with-satisficing model. This lack of direct empirical evidence apparently stems from the lack of careful specification of the assumptions and theoretical implications of such a model.

It is the purpose of this chapter to provide both a theoretical analysis of the implications of a supply-induced-demand-with-satisficing model and a direct empirical estimate of that model. It is not the purpose of this chapter to advocate or condemn the assumptions behind such a model. The analysis accepts as given certain assumptions which, in the author's opinion, reasonably represent the underlying foundations of supply induced demand models. The implications of these assumptions are analyzed, and an empirical model based upon these implications is estimated.

Among the surprising conclusions of the analysis is the fact that the empirical result most frequently cited as evidence for the supply induced demand hypothesis can not be predicted by that model. Therefore, this common empirical finding (or its opposite) offers no evidence for or against the supply induced demand hypothesis.

Further, the model, in conjunction with its parameter estimates, provides a method of estimating the likelihood that an increase in the number of physicians in any market would result in increased demand in that market. And finally, the model provides a framework for empirical analysis of the determinants of an individual physician's target level of income.

The next section of this chapter provides a brief, non-exhaustive summary of empirical findings which have led researchers to entertain the supply shifting hypothesis. The following section suggests various possible sets of assumptions which can provide a logical foundation for a supply shifting and satisficing model and analyzes the implications for market equilibrium of each set of assumptions.

Then, an empirically testable model which is consistent with these implications is presented. The results of estimation of the model and a summary conclude the chapter.

EMPIRICAL MOTIVATION FOR THE SUPPLY INDUCED DEMAND HYPOTHESIS

In 1972, Victor Fuchs and Marcia Kramer published a study of physician utilization in the U.S. throughout the period 1948-1968. They reported that people who lived in states in which there were a large number of doctors relative to the population tended to purchase more physician services than their counterparts in states with relatively fewer doctors. This result was found even after accounting for price differentials. In a cross sectional analysis of physician utilization by states in 1966, the quantity of medical services consumed per capita was regressed upon average price, per capita income, and the number of physicians per capita. The coefficient of the physician per capita variable was positive and highly significant. Furthermore, the estimated elasticity of demand with respect to the number of physicians per capita, + .4, was large relative to the elasticities of demand with respect to income and insurance. These results led Fuchs and Kramer to express the following warning:

> Because physicians can and do determine the demand for their own services to a considerable extent, we should be wary of plans which assume that the cost of medical care would be reduced by increasing the supply of physicians.[2]

In an article published in 1970, Joseph Newhouse analyzed the variance of the price per office visit charged by general practictioners across 18 SMSA's. After accounting for per capita income differentials, he found a partial correlation between price and the number of physicians per capita of + .55.

While the thesis of the article was that a competitive supply-demand model did not adequately represent physician service markets, the author noted that the data did not perfectly fit a monopolistic profit maximizing model either. He suggested that one possible explanation was that doctors satisfice, or set target levels of income:

> As the number of physicians in an area increases, visits per physician will tend to fall. To achieve any given target income, each physician will have to charge higher fees.[3]

The validity of the supply induced demand model was strongly urged by Robert Evans in two separate papers. In the first, Evans et al. (1973) studied gross billings per physician in cities in British Columbia throughout 1969. At the time of the study, physicians' fees were set according to a standard province-wide fee schedule. Therefore, Evans et al. argued, in the absence of either demand creation by physicians, or permanent excess demand for physicians' services, an increase in the number of physicians per capita should lead to a decrease in the average workload of each physician. That is, the elasticity of gross billings per physician with respect to the number of physicians per capita should equal -1. Empirical estimates of the elasticity, however, fell in the vicinity of zero. Evans further estimated the elasticity of total per capita expenditure for physicians' services with respect to the number of physicians per capita as + .85.

In a second article, Evans (1974) proposed a model in which physicians are assumed to have rough targets of income and workload which are based upon their training, expectations, and previous experience. If income and workloads fall below target levels, demand generation takes place. If physicians feel overworked and underpaid, upward pressure on prices may develop. According to Evans, the implications of such a model would include upward pressure on price when supply increases, as well as relatively little response of income per physician. Furthermore, "the primary function of price is (in conjunction with workloads) to achieve physician income targets."[4]

Fuchs (1976) estimated the demand for operations across geographic areas throughout the period 1963-1970. His results led him to conclude that: "Other things equal, a 10 percent higher surgeon/population ratio results in about a 3 percent increase in the number of operations and an increase in price."[5] Fuchs noted that these results raise the troublesome question of why surgeons don't increase demand even more than they do. He suggested that one possible answer was that incomes and workloads were already satisfactory.

Other empirical studies[6] have also found positive partial correlations between the number of physicians per capita and service demands, (May, 1975), or fees (Huang and Koropecky, 1973).[7]

Such empirical findings, although common, have not been universal. For example, Sloan (1976) and Steinwald and Sloan (1974) have found negative partial correlations between prices and physicians per capita.

THEORETICAL IMPLICATION OF THE SUPPLY INDUCED DEMAND AND TARGET INCOME HYPOTHESES

The phenomena of "supply induced demand" and "target income pricing" will be initially analyzed in a supply and demand framework. Market equilibrium will be characterized first in the case in which physicians seek target levels of income, but can not induce demand, and then in the case in which physicians can induce demand in order to achieve their target incomes.

Implications of the Target Income Hypothesis Without Demand Inducement.

Suppose that the economic decisions of each physician concerning inputs, output, and price are guided by the goal of earning a target level of income. Two alternative definitions of "income" appear plausible.

Conventional microeconomic theory of the firm would suggest that a physician's profit, or net income, is the relevant measure of "target." However, behavioral theories of the firm might suggest that revenue, or gross income, is the entity of concern to the physician.[8] Since there is no apparent a priori reason to choose one definition over the other, both alternatives will be considered, with the latter definition employed first.

Let T_i represent the target level of gross income (revenue) chosen by the i^{th} physician. Then the supply schedule of the i^{th} physician simply represents all combinations of price and output[9] which yield T_i dollars. Letting q_i represent the quantity of services which the i^{th} physician would be willing to supply at price P_i, this schedule can be represented mathematically as follows:

$$P_i q_i = T_i \qquad \text{(11-1a)}$$

or

$$P_i = \frac{T_i}{q_i} \qquad \text{(11-1b)}$$

Equation (11-1b) indicates that the individual physician's inverse supply function may be graphically represented as a rectangular hyperbola. That is, the physician's supply curve is everywhere downward sloping.

An aggregate, or market, supply may be derived from the individual physician supplies under an appropriate assumption about market behavior. Specifically, it is assumed that there exist enough reasonably well informed and mobile consumers that all doctors in a given market must charge approximately the same price per unit of service. With this assumption, it makes sense to define a market price, P, and a market quantity, Q, which would be supplied at that price. By equation (11-1):

(11-2a) $$Q \equiv \sum_i q_i = \frac{1}{P} \sum_i T_i$$

or

(11-2b) $$P = \frac{\Sigma T_i}{Q}$$

where the summation includes all physicians in the market. Thus aggregate supply is also mathematically represented by a rectangular hyperbola.

Given aggregate supply, the market equilibrium can be derived graphically by superimposing the market supply and demand curves, as illustrated in figure 11-1. Since the supply curve has negative slope, problems of stability must be taken into account.

Assumption 1

It is assumed that market forces cause price to rise in response to excess demand and to fall in response to excess supply.

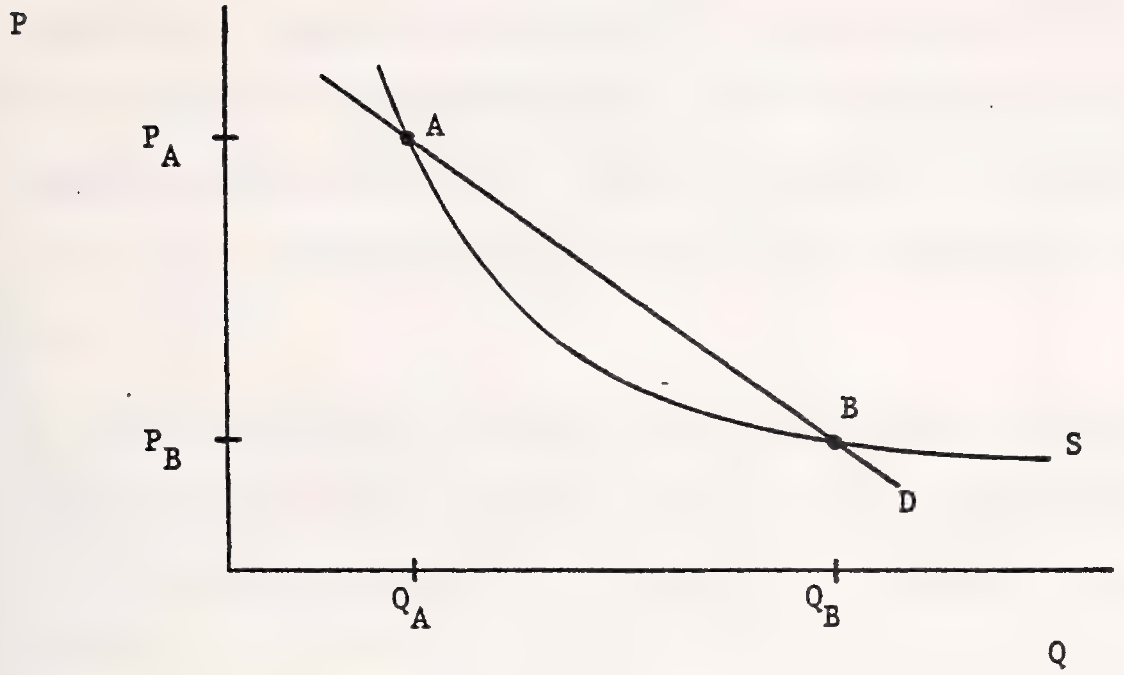
Assumption 1 implies that the equilibrium designated by point B in figure 11-1 is unstable, since there will be excess demand at prices greater than P_B and excess supply at prices smaller than P_B. Assumption 1 further implies the following theorems.

Theorem 1

Let P* represent an equilibrium price defined by the intersection of any downward sloping demand function and the downward sloping supply function implied from the target model, i.e., PQ = T. The price P* represents a stable equilibrium only if demand is elastic at that price.

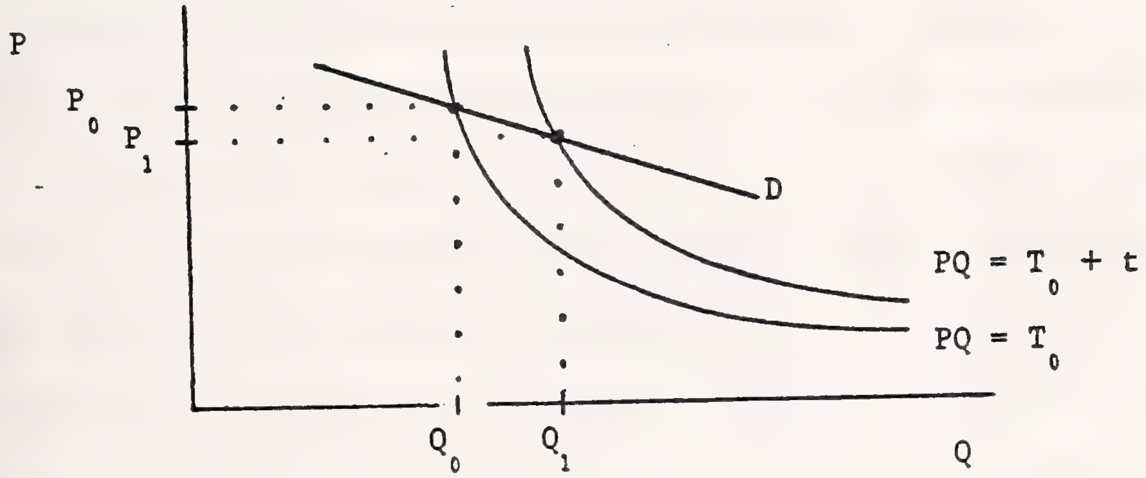
Proof:

Assumption 1 implies that P* can represent a stable equilibrium only if the inverse supply function is more steeply sloped in the vicinity of P* than the inverse demand function. This requires:



Supply and Demand without Demand Inducement
Gross Income Target

Figure 11-1



Effect of an Increase in Supply of Physicians

Figure 11-2

(11-3) $\left.\frac{dQ}{dP}\right|_S \frac{P^*}{Q^*} > \left.\frac{dQ}{dP}\right|_D \frac{P^*}{Q^*}$ for stability with downward sloping supply and demand.

That is, stability requires that the elasticity of supply exceed the elasticity of demand at price P*. But by equations (11-2), the elasticity of supply equals -1. Therefore stability requires that the elasticity of demand at price P* be algebraically smaller than -1.

Q.E.D.

Theorem 2

An increase in the number of physicians in a market in a state of stable equilibrium must lead to a decrease in the price of physicians' services and an increase in expenditure upon physicians' services.

Proof:

Let P_0, Q_0 represent the original equilibrium price and quantity. Let T_0 represent the aggregate target levels of revenue of the original physicians in the market. Since P_0, Q_0 represents a point on the supply curve, it must be true that $P_0 Q_0 = T_0$.

Let t represent the aggregate target of the new physicians which enter the market. Then the new equilibrium price and quantity (P_1, Q_1) must be such that $P_1 Q_1 = (T_0 + t)$. That is, total expenditures on physician services must increase with the increase in the number of doctors. But by theorem 1, the original equilibrium can be stable only if demand is elastic at price P_0. Thus, total revenue can increase only if price is decreased. That is, in order that: $P_1 Q_1 > P_0 Q_0$ it is necessary that: $P_1 < P_0$.

Q.E.D.

Theorem 2 is illustrated in figure 11-2. An increase in the number of physicians shifts the supply curve to the right. At the original price P_0, there would exist an excess of supply. By assumption 1, price would fall until the new equilibrium level P_1 is reached.

The existence of an equilibrium under this market system can not be guaranteed. There may be so many physicians in a market that the supply curve does not intersect the demand curve. Clearly, in such a case, not all physicians can earn their target incomes, and, therefore, the target income model can not apply. This problem will be further considered below.

Theorem 2 implies that the target gross income (without demand shifting) model can not provide an explanation of anomalous empirical results. Qualitatively, the target model predicts the same effect upon price of an increase in the number of physicians as that predicted by a standard supply-demand model. Quantitatively, however, the downward sloping supply curve of the target model implies an even greater reduction in price in response to increased physician supply.[10] The analysis will therefore turn to a model which employs the alternative definition of "income."

Suppose that the economic decisions of each physician are made with the purpose of earning a target level of net income or profit. Let T_i^* represent the i^{th} physician's target level of profit, and let $C_i(q_i)$ represent the cost which must be incurred by the i^{th} physician to supply the level of services q_i. Then the supply schedule of the i^{th} physician represents all those price -quantity pairs which satisfy the condition that $P_i q_i - C_i(q_i) = T_i^*$ That is:

$$P_i = \frac{T_i^*}{q_i} + \frac{C_i(q_i)}{q_i} \tag{11-4}$$

Equation (11-4) indicates that the inverse supply function for the i^{th} physician may be derived graphically as the sum of average cost $C_i(q_i)/q_i$

plus average profit (T_i^*/q_i). This technique is illustrated in figure 11-3.

The slope of the inverse supply function may be determined by differentiating equation (11-4) with respect to output.

$$\frac{\partial P_i}{\partial q_i} = - \frac{T_i^*}{q_i^2} + \frac{\partial [C_i(q_i)/q_i]}{\partial q_i} \tag{11-5}$$

Expression (11-5) may be rewritten by performing the differentiaion on the right hand side of that equation and substituting equation (11-4).

$$\frac{\partial P_i}{\partial q_i} = \frac{1}{q_i} [C_i'(q_i) - P_i] \tag{11-6}$$

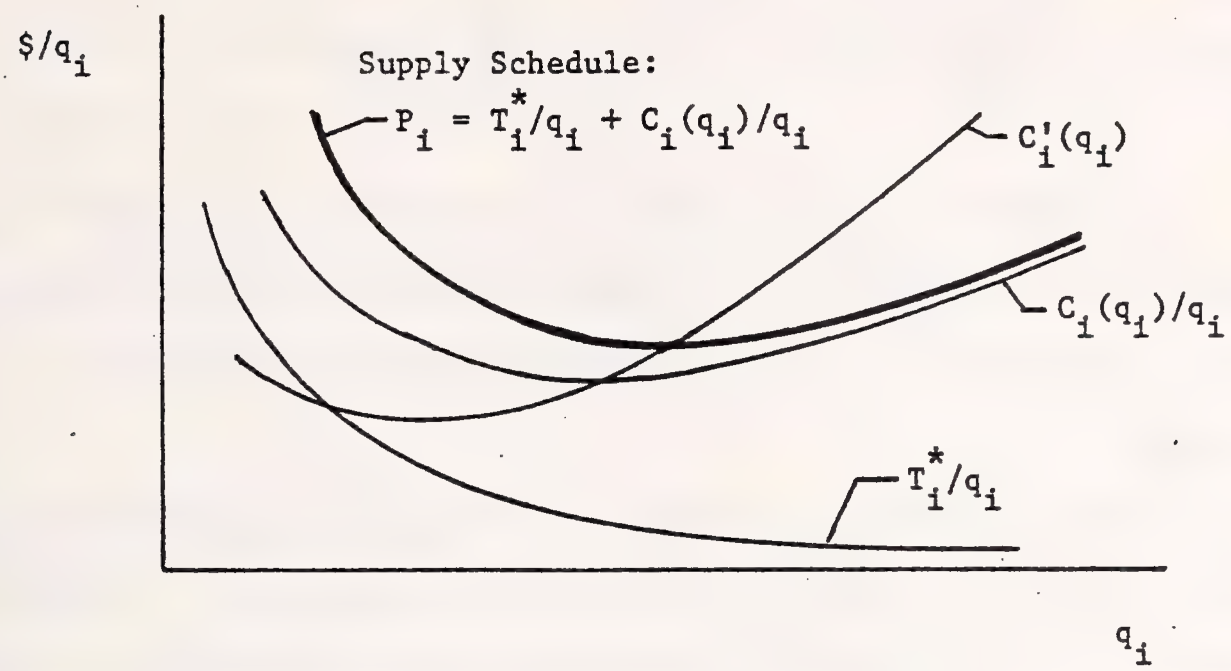
By equation (11-5), a physician's inverse supply function can be expected to have negative slope at small levels of output, if there exist any fixed costs or economies of scale. Furthermore, the inverse supply function is negatively sloped at every level of output if average cost is a nonincreasing function of output.

In cases in which diseconomies of scale result in a positive sloping segment of the inverse supply function, ambiguities arise, since quantity supplied is not a single valued function of price. In such cases, derivation of the physician's supply function requires further assumptions concerning which price—quantity pair the physician would choose.

The physician's elasticity of supply at any chosen price - quantity pair may be derived by differentiating equation (11-4):

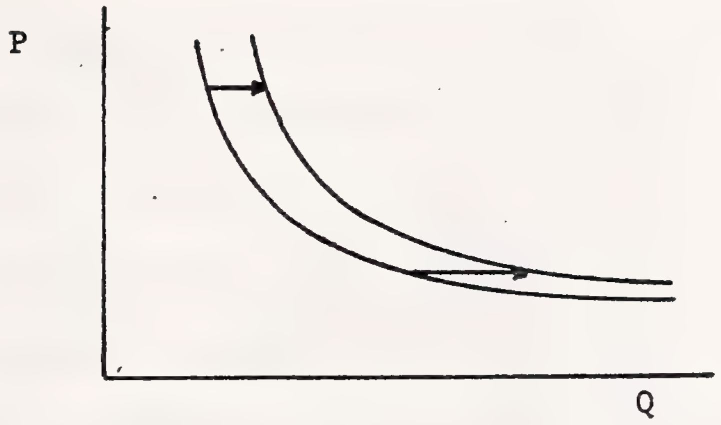
$$\frac{dq_i}{dP_i} \frac{P_i}{q_i} = - \frac{P_i}{P_i - C_i'(q_i)} \tag{11-7}$$

Equations (11-6) and (11-7) together imply that the elasticity of supply must be algebraically smaller than -1 at every price - quantity pair at which



Derivation of Physician's Supply Schedule
Net Income Target

Figure 11-3



Effect upon Equilibria of an Increase in
Supply of Physicians

Figure 11-4

the inverse supply function has negative slope. That is:

$$\left.\frac{dq_i}{dP_i}\right|_S \frac{P_i}{q_i} < -1 \qquad \text{for} \quad \left.\frac{dP_i}{dq_i}\right|_S < 0 \tag{11-8}$$

An aggregate supply function can be derived without further assumption if all physicians' inverse supply functions are downward sloping. In this case, a result analogous to Theorem 2 can be derived.

Theorem 3

Assume that either: (a) average cost is a nonincreasing function of output for every physician, or (b) no physician chooses to supply a quantity of services so large that marginal cost exceeds price. Then an increase in the number of physicians in a market currently in stable equilibrium will lead to a decrease in equilibrium price and an increase in expenditures upon medical services.

Proof:

Given condition (a) or (b), each physician chooses only price quantity pairs along a negatively sloped segment of his inverse supply. By equation (11-8), this implies that each physician's elasticity of supply is algebraically smaller than -1. Since the elasticity of aggregate supply is equal to a weighted average of the individual elasticities, aggregate elasticity of supply must be less than -1. Therefore, stability requires that the elasticity of demand at equilibrium be algebraically smaller than -1. Thus a rightward shift of the supply curve must result in a decreased equilibrium price and an increase in expenditures.

Q.E.D.

If some physicians have upward sloping supply functions, then an increase in the number of physicians will not necessarily lead to an increase in expenditures. However, price must decrease.

Theorem 4

An increase in the number of physicians in a market in a state of stable equilibrium must lead to a decrease in the price of physician services.

Proof:

Equilibrium in any supply and demand system may be represented as the solution to the following equations.

$$Q^d = D(P)$$
$$Q^s = S(P, y)$$
$$Q^d = Q^s$$

where y represents an exogeneous supply shifting factor. Let subscripts denote differentiation. Assume by definition that $S_y > 0$. The effect upon equilibrium price of an increase in supply may be calculated as follows:

$$\text{(11-9)} \qquad \frac{dP}{dy} = \frac{-S_y}{S_p - D_p}$$

Consider first the case that enough physicians have downward sloping supply curves that the aggregate supply has negative slope. In this case, equation (11-3) implies that the equilibrium can be stable only if $S_p - D_p > 0$. But then by equation (11-9), $dP/dY < 0$. Next consider the case that the aggregate supply curve has positive slope. In this case it must be true that $S_p - D_p > 0$. Therefore $dP/dY < 0$.

Q.E.D.

Theorems 3 and 4 indicate that the predictions of the net income target model are not seriously different from the predictions of the gross income target model. One may conclude, therefore, that target income behavior by itself will not lead to anomalous relationships between price and supply.

Implications of the Target Income Hypothesis with Demand Inducement

The analysis of the implications of demand inducement will be performed first under the assumption that demand can be shifted without limit, and then under a more realistic assumption that demand can be shifted only within a limited range.

Suppose that doctors can shift consumer demands without limit. That is, by giving advice, doctors may shift the market demand function so that it passes through any desired point in quantity-price space. In this case, the concept of consumer demand is almost meaningless. The locus of all possible market equilibria is independent of demand and is represented simply by the market supply curve. This is true because the proper amount of "advice" can cause the demand curve to intersect any point on the supply curve.

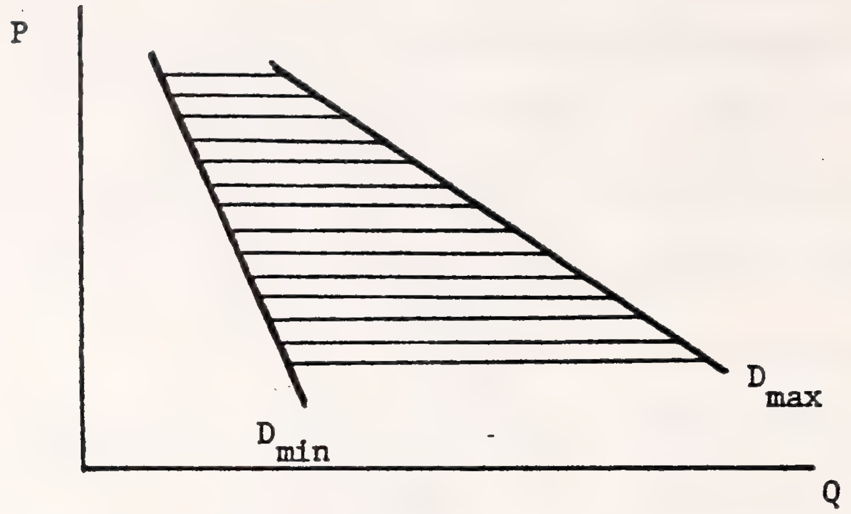
This model makes no predictions about the level of price or the quantity of output other than that the price and quantity must yield the target levels of income to physicians. In the case that "income" is defined as gross income, equilibrium requires only that the product of price times quantity equal the aggregate of physicians' targets. For example, this model predicts that an increase in the number of physicians will lead to a proportionate increase in expenditures for physician services. However, the model is silent concerning the effect upon the level of price. This indeterminate effect upon equilibrium of an increase in supply is illustrated in figure 11-4.

The implications of this model for empirical analysis are quite surprising. Since consumer demand does not determine market equilibrium, only variables which affect the aggregate target income can affect equilibrium price and quantity. Variables which can be expected to affect only consumer demand, such as population and insurance coverage, have no effect upon equilibrium, and therefore should not appear in any regression equations. Estimation of a demand function makes no sense. Furthermore, since equilibrium price and quantity are indeterminate, estimation of the supply of physicians would be accomplished most efficiently with the choice of income as the dependent variable.

These drastic implications may be questioned because of the extreme assumption of unlimited demand shifting potential of this model. Certainly it seems unlikely that each consumer could be induced to spend more than his expected lifetime earnings on physicians' services. The possible implications of limits to the extent to which demand can be shifted therefore should be investigated.

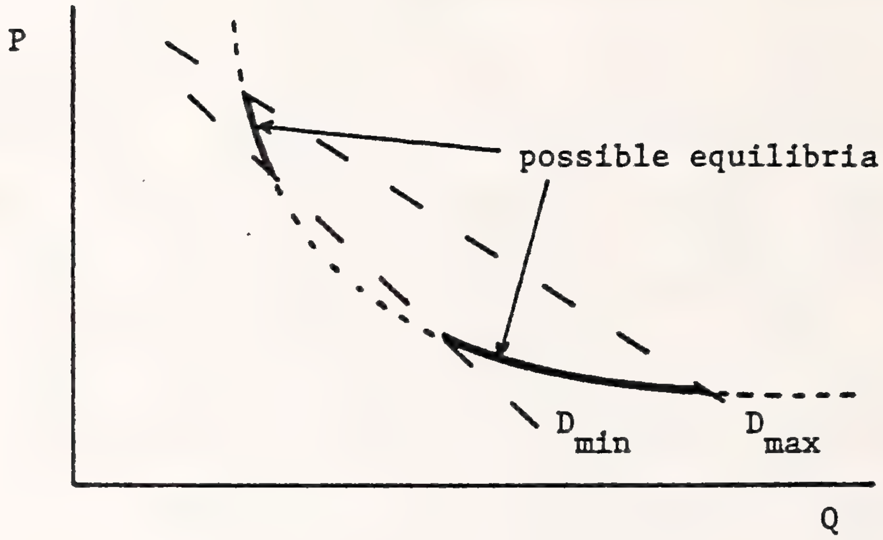
Suppose doctors can shift demand only within a limited range. It seems reasonable to represent consumer demand in this case by two demand functions; namely, a minimum demand, which represents quantity demanded at each price when doctors discourage demand to the maximum extent, and a maximum demand, which represents quantity demanded at each price when doctors encourage demand to the maximum extent. It is assumed that demand may be shifted so as to pass through any point which lies between these two extreme demand curves. A possible pair of maximum and minimum demands are illustrated in figure 11-5. The entire range of demand is represented by the shaded area between the two curves.

Possible market equilibria consist of all points at which supply and demand can be equated. The locus of these points is represented by those portions of the supply curve which lie within the feasible range of demand. Such an equilibrium locus is illustrated in figure 11-6.



Feasible Region of Demand with Limited Inducement

Figure 11-5



Equilibria with Target Income
and Limited Demand Inducement

Figure 11-6

The set of potential equilibrium quantity-price pairs in this model is simply a subset of the set of equilibrium points of the previous model (in which potential demand shifting was unlimited). Therefore, the predictions of this model, in general, are the same as the predictions of the previous model. A few additional predictions may be derived in the special cases in which the constraints upon demand are binding. Specifically, if the market is currently in equilibrium at a price-quantity pair located at the intersection of the minimum demand curve with the supply curve, then an exogenous increase in demand or decrease in physician supply must result in a price change. Similarly, if the market is currently in equilibrium at a price-quantity pair located at the intersection of the maximum demand curve with the supply curve, then an exogenous decrease in demand or increase in supply must result in a price change. Both these situations correspond directly to supply and demand equilibria in the case of no demand inducement. Therefore the effects of these exogenous shifts must be the same as those considered in the previous section. That is, in these two exceptional cases, a change in supply or demand will result in qualitatively the same effect as those predicted by a standard supply and demand model.

As in the case of unlimited demand shifting, the limited supply-induced demand model predicts that exogenous changes in variables which affect only consumer demand generally have no effect upon expenditures for medical services. Total expenditures depend only upon the aggregate level of physicians' targets. Thus, empirical estimation of a demand function when demand inducing behavior is suspected is meaningless. Furthermore, (with the exception of the two cases mentioned), a demand inducing model can make no predictions concerning the response of price to changes in supply or demand variables.

As in the case of the target income behavior without demand inducement, existence of a market equilibrium can not be guaranteed if potential demand inducement is bounded. The existence of a maximum extent to which any consumer's demand may be shifted implies the existence of a maximum level of expenditures which can be extracted from any set of consumers of medical service. This maximum is determined by the point of unit elasticity on the maximum demand curve. If the aggregate level of target incomes is so large as to require revenues greater than this maximum, clearly, the aggregate target can not be attained.

An analysis of market equilibrium in such a circumstance requires behavioral assumptions beyond those of the target income hypothesis. For the purposes of the empirical analysis of this paper, it will be assumed that, in such a case, physicians as a group do the best they can, given the circumstances. That is, it will be assumed that physicians as a group maximize aggregate income subject to the maximum demand constraint.[11] Thus it will be assumed that in a situation of "permanent excess supply," one price and aggregate quantity of service is agreed upon. This price and service level are independent of the aggregate supply function. This assumption implies that the equilibrium price, quantity, and level of expenditures are determined solely by the maximum demand function.

SPECIFICATION OF AN EMPIRICALLY TESTABLE MODEL

It is the purpose of this section to propose an empirical model which is based upon the implications of the theoretical analysis. This model includes the following basic structure. Each physician, denoted by the index j, possesses a target level of income, T_j^*. For each consumer, there exists an upper limit to the amount which he is willing to spend on physicians' services. If all doctors, treated as a group, attempt to extract revenues greater than the aggregate of all consumers' maxima, then target income levels can not be achieved. Otherwise, through appropriate demand manipulation, each physician manages to earn his target income. It is assumed that physicians' targets apply to net income, or profits. Therefore, the consumers' maximum expenditure constraint can be made operational only by specifying some correspondence between profits and revenues. For simplicity, it is assumed that the profit earned by each physician is proportional to the revenue earned by that physician. Given this assumption, the i^{th} consumer's maximum level of expenditures can be measured as the maximum number of dollars that consumer is willing to contribute to net incomes of physicians, denoted by M_i.

Let R_j represent the net income realized by the j^{th} physician in a market. Then the model predicts that:

$$\text{(11-9a)} \qquad R_j = T_j^* \qquad \text{if } \sum_j T_j^* \leq \sum_i M_i$$

If the sum of physicians' targets exceeds the aggregate expenditure maximum, it is assumed that the physicians as a group will extract that maximum expenditure, and these earnings will be divided approximately equally among all doctors. That is:

$$\text{(11-9b)} \qquad R_j = \frac{\sum_i M_i}{J} + \theta_j \qquad \text{if } \sum_j T_j^* > \sum_i M_i$$

where J equals the number of doctors in the market, and θ_j represents a random, or error term.

To further specify the model, it is assumed that the target of the j^{th} physician may be represented as the sum of a linear function of r exogenous variables, $y_{j1}, \ldots y_{jr}$, plus an error term:

(11-10) $$T_j^* = \sum_{k=1}^{r} t_k y_{jk} + \varepsilon_j$$

It is further assumed that the maximum number of dollars which the i^{th} consumer is willing to contribute toward the income of physicians in that market may be represented as the sum of a linear function of s exogenous variables $x_{i1}, \ldots x_{is}$, plus an error term.

(11-11) $$M_i = \sum_{k=1}^{s} m_k x_{ik} + \mu_i$$

With observations of physicians' incomes and exogenous variables in various markets, equations (11-10) and (11-11) could be estimated by OLS if one knew the markets in which the maximum expenditure constraints were binding. Of course, this latter information is not available. Therefore, these equations must be estimated by a maximum likelihood technique which simultaneously estimates the equations and the probabilities that the maximum expenditure constraint is binding in each market. The details of the assumptions required for this procedure, and specification of the likelihood function, are described in Sweeney (1980).[12]

EMPIRICAL RESULTS

The model represented by equations (11-9) through (11-11) was estimated with data from the 1975 HCFA-NORC survey. These data include measures of income and various characteristics of 877 physicians in 30 SMSA's (or counties) throughout the U.S. (see Sloan, et al., 1978a) for a thorough description of this data set). Each SMSA was assumed to represent a separate market for physicians' services. These markets ranged in size from a population of 7,000 (Morris County, Ka.), to a population of 9,885,000 (New York). The physicians surveyed included pediatricians, general surgeons, general/family practitioners, internists, and obstetricians/gynecologists.

The results of the estimation are summarized in Table 11-2. Three separate sets of estimates are reported. Model 1 assumes that both a physician's target and the maximum which any consumer is willing to spend are totally independent of exogenous variables. That is, both targets and maxima are purely random numbers. Model 2 assumes that the target of each physician depends upon the number of years of post medical school training required for his specialty, the average income level of the community in which he works, the number of children which he has, and whether the physician is affiliated with a medical school. The maximum expenditure level of a consumer is assumed to depend upon that consumer's income level, the number of children in the consumer's family, insurance coverage, and race.[13] Model 3 is a simplified version of model 2, which includes only those variables of model 2 which have coefficients significantly different from zero at the 90% confidence level.

Detailed descriptions of the variables are presented in Table 11-1. The variables are scaled so that the target level of income is measured in thousands of dollars, and the maximum contribution per consumer toward physicians' incomes is measured in dollars. All financial variables were deflated by a local cost of living index.

The estimates of model 1 suggest an average target level of income of approximately $70,000. Since the average level of realized income in the sample equaled $55,077, it is apparent that some physicians goals must have been frustrated. Consumers could be expected on average to balk at contributing more than $49.60 to the annual income of physicians in the 5 specialty classes.[14]

The parameter estimates of model 2 suggest that a physician's target level of income: (i) increases by $10,000 for each additional year spent in post medical school training, (ii) increases by $15,600 per $1,000 increase in the average income level of the community, and (ignoring significance tests), (iii) increases by $3,000 per child in his family, and (iv) is

Table 11-1: Description of Exogenous Variables

All variables are obtained from the 1975 HCFA-NORC Physician Practice Cost Survey, except where otherwise specified.

No. yrs. training: number of years post medical school training required for specialty:

pediatrics = 3
obstetrics & gynecology = 4
general surgery = 4.5
general/family practice = 0
internal medicine = 3

(source: Directory of Medical specialties, 18th ed., Chicago: Marquis)

Community per capita income: per capita income of SMSA, adjusted by local cost of living index for intermediate family of four. (Cost of living index source: BLS Handbook of Labor Statistics, 1975,))

No. of children in family: number of children in physician's family

faculty affiliation: equal to 1 if physician is a member of a medical school faculty, 0 otherwise.

income: same as "community per capita income"

% under 15: percentage of population aged 14 and under.

% without insurance: percentage of population with no insurance, adjusted for specialty mix.

% minority: percentage of population which is Black or Hispanic

% over 64: percentage of population aged 65 and older.

Table 11-2: Parameter Estimates and T-Statistics, Three Models of Physician Income Determination

	Model 1	Model 2	Model 3
PHYSICIAN'S TARGET INCOME [equation (11-10)]			
constant	69.96 (22.48)	-42.76 (-1.63)	-31.82 (-1.22)
no. yrs. training		10.00 (2.95)	8.30 (2.77)
community per capita income		15.64 (3.14)	15.50 (2.97)
no. of children in family		2.89 (0.83)	
faculty affiliation		-12.58 (-0.91)	
CONSUMERS' MAXIMUM PER CAPITA CONTRIBUTION TO INCOME [equation (11-11)]			
constant	49.64 (22.18)	100.05 (1.79)	89.23 (3.71)
income		14.55 (3.52)	14.57 (4.00)
% under 15		-4.47 (-3.05)	-4.08 (-3.76)
% without insurance		-0.42 (-0.89)	
% minority		0.27 (1.02)	
% over 65		0.03 (0.01)	
Log (Likelihood):	-4218.58	-4202.53	-4204.06

$12,600 smaller for physicians who are affiliated with a medical school faculty. Note that one can not with reasonable confidence reject the hypotheses that number of children and faculty affiliation have no effects upon the target. The maximum per capita amount consumers are willing to contribute to the profit of doctors of the 5 specialties: (i) increases by $14.6 per $1,000 of per capita income, (ii) decreases by $4.5 per 1% of the population composed of children, and (ignoring significance levels) (iii) decreases by $.4 per 1% increase in the portion of the population without medical insurance, (iv) increases $.3 per 1% increase in the portion of the population who are minorities, and (v) is not affected by the fraction of the population composed of senior citizens. One cannot with reasonable confidence reject the hypotheses that per cent without insurance, per cent minority, and per cent senior citizens have no effects upon the maximum per capita expenditure level.

Employing the coefficients and variance estimates, one may derive the probability that the aggregate of the targets in one market will exceed the aggregate of the expenditure maxima of consumers in that market. These estimates are presented in Table 11-3.

Under the assumptions of model 1, the probability that the aggregate of targets exceeds the aggregate of expenditure maxima in any market depends only upon the population and number of physicians in that market.[15] Given the parameter estimates of that model, the probability that the aggregate of targets exceeds the aggregate of maxima must be greater than 1/2 in any market that has more than one physician per 1409.3 consumers, (or, equivalently, more than 71 physicians per 100,000 population). Under the assumptions of models 2 and 3, the probability that the sum of targets exceeds the aggregate maximum expenditure level depends also upon the values of the exogenous variables.

Table 11-3: Estimated Probabilities of Physicians Not Achieving Target Incomes by SMSA, 1975

SMSA	Population (thousands)	Population / No. Physicians	$Pr \sum_j T_j^* > \sum_i M_i$		
			#1	#2	#3
Birmingham, Al.	749	1,140	.78	.78	.87
Fresno, Cal.	439	1,202	.66	.89	.80
Los Angeles	6,944	884	1.00	1.00	1.00
San Diego	1,501	949	.99	1.00	.97
Mesa, Co.	19	339	.94	.97	.95
New Britain, Ct.	943	1,116	.83	.95	.87
Springfield, Ma.	605	1,276	.62	,91	.72
Orlando, Fa.	572	1,303	.59	.88	.68
Atlanta	1,733	1,186	.82	.99	.95
Chicago	7,090	1,236	.92	1.00	1.00
St. Louis	2,382	1,363	.58	.87	.85
Morris Co., Ka.	7	2,333	.45	.41	.35
Topeka, Ka.	194	1,426	.49	.59	.51
New Orleans	1,092	1,068	.89	1.00	1.00
Flint, Mi.	524	1,851	.26	.90	.79
Detroit	4,469	1,471	.37	1.00	.98
Carroll, Mo.	12	3,000	.41	.24	.27
Great Falls, Mont.	85	1,012	.66	.84	.73
Newark	2,080	1,048	.97	.99	.99
New York	9,885	944	1.00	.85	.91
Johnston Co., N.C.	64	2,560	.34	.35	.28
Wilkes, N.C.	54	3,600	.30	.28	.28
Columbus, Oh.	1,070	1,391	.52	.68	.63
Armstrong Co., Pa.	75	2,885	.30	.28	.24
Reading, Pa.	304	1,165	.67	.51	.34
Philadelphia	4,834	1,165	.96	.76	.89
Florence, S.C.	92	1,179	.59	.75	.75
Wichita Falls, Tx.	128	1,255	.57	.53	.45
Chittenden Co., Vt.	107	748	.86	1.00	.97
Marion, W. Va.	64	1,524	.47	.33	.27

The probabilities in Table 11-3 give rough estimates of the likelihood that physicians in a market can achieve their targets. In this sense, the estimates provide an indication of the applicability of the "target income with demand shifting" model. It is interesting to note that under the random model, the probability that physicians can achieve their targets exceeds .5 in only 9 of the 30 markets.[16] This number drops to 8 under model 2 and 6 under model 3. As should be expected, physicians are most likely able to achieve their targets in the small, rural markets. In the large urban areas of New York, Los Angeles, San Diego, Chicago, and New Orleans, the probability that target income pricing prevails is minute.

SUMMARY AND CONCLUSIONS

Without an accompanying assumption of demand inducement, a target income model yields qualitatively the same predictions as those of a standard supply and demand model. An increase in the supply of physicians or a decrease in the demand for their services leads to a lower equilibrium price. Furthermore, if the target pertains to gross income, stable market equilibria can occur only at price levels at which demand is elastic. Therefore, the decrease in price which results from increased supply must be accompanied by increased total expenditure upon physicians' services.

A target income model with an assumption of demand inducement yields surprisingly few predictions. Indeed, enumeration of phenomena which can not be predicted by such a model should be of greater interest to those involved in the current debate about the nature of the physicians' market. Specifically, neither the price level nor its direction of change can be predicted. There can exist no systematic relationship between price and any exogenous variables. If demand inducing behavior is hypothesized, the empirical estimation of any function assumed to represent demand is a meaningless exercise. Furthermore, unless consumers' willingness to pay for physicians' services is unbounded, the feasibility of target seeking behavior must be limited. Thus, any empirical estimation of market characteristics must account for this limited applicability.

The empirical estimates of the determinants of a physician's target level of income and determinants of maximum expenditure ceilings of consumers presented here imply that, for physicians in the five specialties, target seeking behavior is likely to be feasible only in small, rural markets. Stated alternatively, these estimates imply that any potential for demand inducement have most likely been exhausted in all but the smallest markets of the sample.

FOOTNOTES TO CHAPTER 11

[1] The statistics in this paragraph were obtained from: U.S. Bureau of the Census (1978).

[2] Fuchs, V., Kramer M. (1972) p. 2.

[3] Newhouse, J. (1970) p. 181.

[4] Evans, M. (1974) n. 30, p. 168.

[5] Fuchs, V. (1976) p. 54.

[6] For an excellent survey, see Sloan-Feldman (1978).

[7] Neither of these authors suggested demand inducement as an explanation for their findings.

[8] See for example, Baumol (1959).

[9] For the purpose of this analysis, it is assumed that a physician's service is a commodity which can be quantified by a scalar measure.

[10] Let p_s represent the slope of the inverse supply curve (measured at the equilibrium price), and let p_d represent the slope of the inverse demand. Then the effect upon equilibrium price of a rightward shift of supply (or leftward shift of demand) is proportional to $1/[1/p_d - 1/p_s]$. Thus, the smaller (more negative) the p_s, the more negative is the effect upon equilibrium price.

[11] An alternative hypothesis might be that physicians, attempting to maximize their own profits, compete. The alternative in the text was chosen because it appears (to the author) to more closely fit the spirit of the supply induced demand hypothesis.

[12] The following distributions are assumed:

$$\theta_j \sim n(0, \sigma_\theta^2) \qquad \forall j$$

$$\varepsilon_j \sim n(0, \sigma_\varepsilon^2) \qquad \forall j$$

$$\mu_i \sim n(0, \sigma_\mu^2) \qquad \forall i$$

These distributions are assumed to be the same in each market.

Furthermore, it is assumed that the group of physicians from any one market included in the data set compose a representative sample of all physicians in that market. That is, in any one market, the sample average (over physicians from that market) of the vector of exogenous variables $(y_{1j}, \ldots\ y_{rj})$ is assumed to equal the population (of physicians in that market) average.

Let N represent the number of separate markets included in the data set. Let n_k and d_k respectively represent population and number of doctors in market k. Let w_k represent the number of physicians from the k^{th} market included in the sample. The likelihood function has the following general form:

$$L = \prod_{k=1}^{N} G_k$$

where G_k is the sum of two products:

$$G_k = \begin{array}{l} \left[\begin{array}{l}\text{probability of observing the } w_k \text{ incomes given that} \\ \displaystyle\sum_{j=1}^{d_k} T^*_{kj} \le \sum_{i=1}^{n_k} M_{ki}\end{array}\right] \\ \times \left[\text{probability that } \displaystyle\sum_{j=1}^{d_k} T^*_{kj} \le \sum_{i=1}^{n_k} M_{ki}\right] \\ + \\ \left[\begin{array}{l}\text{probability of observing the } w_k \text{ incomes given that} \\ \displaystyle\sum_{j=1}^{d_k} T^*_{kj} > \sum_{i=1}^{n_k} M_{ki}\end{array}\right] \\ \times \left[\text{probability that } \displaystyle\sum_{j=1}^{d_k} T^*_{kj} > \sum_{i=1}^{n_k} M_{ki}\right] \end{array}$$

where the additional subscript k on T^* and M denotes the market.

[13] Since each consumer is assumed to have an expenditure maximum which is linear in the exogeneous variables, the sum of all consumers' maxima can be calculated as a function of the average level of exogenous variables in each community. That is, because of the assumed functional form, data about each individual consumer is unnecessary. Rather, the model can be estimated with measures of the average level of each exogeneous variable in the community (and population).

[14] The data also included estimates of gross income, or revenue, received by each physician. Although the accuracy of these individual estimates are subject to doubt, the average of these figures can probably provide a useful estimate of the relationship between physicians' incomes

and expenditure by consumers. Specifically, the average ratio of estimated gross income divided by net income over all physicians equals 1.62. Applying this number to the coefficient 49.60 in model 1 suggests that the average maximum amount which a consumer is willing to spend for services from the five specialties equals $80.35.

[15] Specifically, let t_0 and m_0 represent the coefficients of the target and maximum equations, respectively. Let ϕ_k represent the population physician ratio in market k. Then:

$$\Pr\left[\sum_{j=1}^{d_k} T_j^* > \sum_{i=1}^{n_k} M_i\right] = 1 - F_{std}\left[\frac{\sqrt{d_k}\, m_0(\phi_k - t_0/m_0)}{(\phi_k \sigma_\mu^2 + \sigma_\varepsilon^2)^{\frac{1}{2}}}\right]$$

where $F_{std}(\cdot)$ denotes the value of the cumulative standard normal distribution function.

[16] The probability that physicians will achieve their targets equals 1 minus the probability that the aggregate of the targets exceeds the aggregate maximum.

Chapter 12

Estimation of the Determinants of Market Equilibrium Under the Target Income Hypothesis

George Sweeney

INTRODUCTION

Studies of the markets for health services frequently assume that doctors and dentists do not maximize profits, but rather seek some satisfactory target income level. (For examples, see Evans, 1973; Evans, 1974; Fuchs, 1978; Fuchs and Kramer, 1972; and Newhouse, 1970.) In addition, it is frequently assumed that as both the sellers of the service and the agents providing advice to the buyers concerning the buyer's needs for that service, health professionals can significantly affect the demand for their services. This chapter proposes a method for estimating relevant characteristics of market behavior when it is assumed that firms seek target levels of income (with or without demand inducement) rather than maximum profits.

It is shown in Chapter 11 that the quantity supplied by a competitive target seeking firm is generally not a single valued function of price, that there generally exist multiple equilibrium price-quantity pairs for a monopolistic target seeking firm facing a given demand, and that for both the competitive and monopolistic firm, the relationship between price and quantity supplied is generally not monotonic. Furthermore, if firms have the ability to shift demand at minimal cost, demand cannot be represented by any estimable function. These characteristics make empirical estimation of structural or reduced form equations for price and quantity extremely difficult.

Much of this difficulty can be avoided by abandoning the choice of price and quantity as the variables of empirical interest. If it is assumed that each firm seeks a target level of income, then selection of the target as a relevant variable can allow meaningful empirical analysis. This chapter presents an example of such an analysis. We propose a model that allows empirical estimation of the determinants of the level of any firm's income target.

Estimation of the determinants of firms' target levels of income requires observations of individual firms' income targets. At first blush it would seem reasonable to employ a firm's actual income as an observation of its income target. But such a procedure requires the assumptions that the firm's realized income does not exceed or fall short of the target income. While the assumption that realized income does not exceed the target level of income is implicit in the target income hypothesis, the assumption that a firm's income will never fall short of its target cannot be justified. Even if firms can shift the demand for their services, there must exist some maximum amount of money that consumers will (or can) pay for the services of any industry. Therefore, if "too many" firms in one market seek "too much" income, the target income levels may not be attained.

This fact poses a major difficulty for empirical analyses of individual firm target seeking behavior. While an entrepreneur's target level of income may be independent of market supply and demand, his ability to achieve that target is not. Thus any empirical analysis of individual firm behavior must take into account the behavior of all firms in the market.

The model proposed in this paper allows estimation of the determinants of the maximum amount consumers are willing to spend for the product or service of an industry and estimation of the likelihood that firms in a given market can achieve their income targets. With appropriate assumptions, the model may be employed to both competitive and monopolistic markets. The model is designed to be estimated with data derived from a "cluster" survey of firms that employs one firm as the unit of observation, but allows grouping of individual observations by market area.

The remainder of this chapter is divided into 5 sections. The first provides an overview of the model and discusses possible applications. Then specific assumptions of the model are enumerated and the likelihood function conditional on the observed data is derived. To illustrate the model, the characteristics of the markets for physicians' services in 30 cities in the United States are estimated in the penultimate section and summary and conclusions are contained in the final section.

OVERVIEW OF THE TARGET MODEL

The model of market equilibrium which we propose assumes that each firm chooses a target rate of output (or a target rate of output and price pair if the firm possesses sufficient market power) consistent with some target income level. As long as satisfaction of all firms' targets does not require expenditure in excess of the maximum that consumers are willing to pay, each firm realizes its income goal (through appropriate price-quantity or demand shifting choices). If the satisfaction of all firms' targets would require expenditures in excess of the maximum that consumers are willin to pay, firms refrain from price competition. In this case, the firms as a group extract the maximum possible revenue from consumers. By means of non-price competition or some other mechanism, these revenues are shared approximately equally among existing firms.

Application of this model to real markets requires two key assumptions: (i) firms seek target incomes rather than maximum profit, and (ii) in situations in which all targets cannot be achieved, firms refrain from any price competition that would decrease total industry revenue.[1] The firm's ability to affect demand need not be assumed.

Many health economists regard the market for physicians' services as an example of a monopolistic market characterized by demand shifting and target income seeking behavior. Price competition is weak. Market sharing may be accomplished through competition in nonprice service characteristics (such as waiting time, convenience of hours, or attractiveness of office) or through the persuasion of local medical organizations.

The model may also be applied to the analysis of the behavior of competitive target seeking firms in markets for which equilibrium price is independent of local market conditions. An example is the market for automobile service under warranty. Each firm would attempt to provide an amount of service consistent with its target income goals. Price rivalry would be fruitless, since prices are paid by the warrantor rather than the consumer. Similar behavior may be observed in craft labor markets if local prices are determined by national union scales.

SPECIFICATION OF THE MODEL

Let n_i represent the number of consumers in the i^{th} market area, and let d_i represent the number of firms serving that market. It is assumed that the j^{th} firm has a target level of income, T^*_{ij}, which may be represented by the sum of a linear function of r exogenous variables, $\tilde{y}_{ij}$, plus an error term, ε_{ij}.

$$(12\text{-}1)\quad T^*_{ij} = \tilde{t}'\tilde{y}_{ij} + \varepsilon_{ij} \qquad j = 1,\ldots, d_i$$

where $\tilde{t}$ denotes an r dimensional vector of coefficients and $\tilde{y}_{ij}$ denotes an r dimensional vector of exogenous variables.

It is assumed that the j^{th} consumer in the i^{th} market will never purchase more than e_{ij} dollars worth of the service or commodity. In the case that firms are assumed to have the ability to induce demand for their services, e_{ij} is determined by the maximum extent that demand can be shifted. In the case that firms are not assumed to have such power, e_{ij} corresponds to the purchases of the i,j^{th} consumer at the price level which prevails in a state of "excess supply."[2] It is assumed that e_{ij} may be represented by the sum of a linear function of s exogenous variables, $\tilde{x}^*_{ij}$, plus an error term μ^*_{ij}.

$$(12\text{-}2) \qquad e_{ij} = \tilde{m}^{*\prime}\tilde{x}^{*}_{ij} + \mu^{*}_{ij} \qquad\qquad j = 1,\ldots,n_i$$

where $\tilde{m}^{*}$ denotes an s dimensional vector of coefficients and $\tilde{x}^{*}_{ij}$ denotes an s dimensional vector of exogenous variables.

Let x_i represent the vector of average values of the exogenous variables throughout the population of the i^{th} market:

$$(12\text{-}3) \qquad \tilde{x}_i \equiv \frac{1}{n_i}\sum_{j=1}^{n_i} \tilde{x}^{*}_{ij}$$

Let E_i represent the maximum amount of expenditures that can be extracted from all consumers in the i^{th} market, namely, the sum over all consumers of the e_{ij}'s.[3] Equations (12-2) and (12-3) imply:

$$(12\text{-}4) \qquad E_i = n_i\tilde{m}^{*\prime}\tilde{x}_i + \sum_{j=1}^{n_i} \mu^{*}_{ij}$$

The assumption of target seeking behavior implies that the maximum expenditure constraint affects market phenomena only in the case that all firms, treated as a group, attempt to extract revenues greater than E_i. If firms seek target levels of net income (profit) rather than gross income (revenue), some correspondence between profit and revenue must be assumed to make this constraint operational. For simplicity, it is assumed that the profit earned by every firm is proportional to the revenue earned by that firm. Let α denote the ratio of each firm's profit to its revenue.[4] Then the maximum expenditure can be expressed as a maximum amount consumers in the i^{th} market will contribute toward the targets of all firms in that market, M_i.

$$(12\text{-}5) \qquad M_i = n_i\tilde{m}'\tilde{x}_i + \sum_{j=1}^{n_i} \mu_{ij}$$

where $\tilde{m} \equiv \alpha\tilde{m}^{*}$ and $\mu_{ij} \equiv \alpha\mu^{*}_{ij}$

Let R_{ij} represent the income actually earned by the j^{th} firm in the i^{th} market. If satisfaction of all targets in the i^{th} market does not require expenditure in excess of the consumers' maximum, then the j^{th} firm would achieve its target:

$$\text{(12-6a)} \quad \text{if: } \sum_{j=1}^{d_i} T^*_{ij} \leq M_i \quad \text{then: } R_{ij} = T^*_{ij} \quad \text{for all } j.$$

If the sum of the targets of all firms in the i^{th} market exceeds M_i, however, those targets cannot be achieved. In such a case, it is assumed that the existing business is shared approximately equally among the firms.

$$\text{(12-6b)} \quad \text{if: } \sum_{j=1}^{d_i} T^*_{ij} > M_i \quad \text{then: } R_{ij} = \frac{1}{d_i} M_i + \theta_{ij} \quad \text{for all } j$$

where θ_{ij} is a random variable.

With appropriate assumptions concerning the distributions of the random variables ε_{ij}, μ_{ij}, and θ_{ij}, and with observations from various markets of firms' incomes and of exogenous variables $\tilde{y}_{ij}$ and $\tilde{x}_i$, equations (12-1) and (12-5) can be estimated by maximum likelihood techniques. Because the nature of the equilibrium in each market depends upon the individual targets of every firm in that market, however, the necessary information is incomplete if the sample from which the data is derived does not include every firm in each market. The linear form of the equations allows this problem to be solved with knowledge of the relationship between the mean values of the exogenous variables, $\tilde{y}_{ij}$, for the entire firm population, and the mean values of those variables for the group of firms included in the sample.

If it is assumed that the sample of firms taken from any one market is representative of the population of firms in that market, then it is reasonable to assume that the sample average (over one market) of the exogenous variable $\tilde{y}_{ij}$, equals the population average (over that market) of the $\tilde{y}_{ij}$'s. That is, let w_i represent the number of firms from the i^{th} market included in the sample ($w_i \leq d_i$). Without loss of generality, let those firms included in the sample be labelled by the indices 1, 2,..., w_i. It may be assumed that:

$$(12\text{-}7) \quad \frac{1}{w_i} \sum_{j=1}^{w_i} \tilde{y}_{ij} = \frac{1}{d_i} \sum_{j=1}^{d_i} y_{ij} \qquad \text{for all } i.$$

This assumption implies that:

$$(12\text{-}8) \quad \sum_{j=1}^{d_i} \tilde{y}_{ij} = \phi_i \sum_{j=1}^{w_i} \tilde{y}_{ij} .$$

where:

$$(12\text{-}9) \quad \phi_i \equiv d_i/w_i$$

Assumption (12-7) and the consequent equation (12-8) may be employed when estimating equations (12-1) and (12-5) with less than complete sampling.

Finally, the nature of the stochastic terms ε_{ij}, μ_{ij}, and θ_{ij} must be specified. It is assumed that each random variable has a univariate normal distribution of mean zero.[5] Specifically, it is assumed that:

$$\varepsilon_{ij} \sim n(0,\sigma_\varepsilon^2) \qquad \text{for all } i,j$$

$$\mu_{ij} \sim n(0,\sigma_\mu^2) \qquad \text{for all } i,j$$

$$\theta_{ij} \sim n(0,\sigma_\theta^2) \qquad \text{for all } i,j$$

DERIVATION OF THE LIKELIHOOD FUNCTION

Let:

$\lambda_i \equiv \sum_{j=1}^{n_i} \mu_{ij}$

d_i = total number of firms in market i

w_i = total number of firms from market i included in the sample

$\phi_i \equiv w_i/d_i$

$f^n(S_1, \ldots, S_n; \mu_1, \ldots, \mu_n, V)$

$\equiv$ the value at the point $(S_1, \ldots, S_n)$ of the n-dimensional joint normal density function of mean $(\mu_1, \ldots, \mu_n)$ and the covariance matrix V.

$F(S;\mu,v)$ $\equiv$ the value at point S of a cumulative univariate normal distribution of mean μ and variance v.

In this section, the following result is proved.

> Given observations of income (R_{ij}) and the exogenous target determining variables $(\tilde{y}_{ij})$ for w_i firms, and observations of the averages of exogenous maximum determining variables $(\tilde{x}_i)$ in each of N different markets (i = 1, ..., N), the likelihood function for the coefficients and variances in equations (12-1), (12-5), and (12-6), on those observations, may be expressed as follows.

$$L(\tilde{m}, \tilde{t}, \sigma_\varepsilon^2, \sigma_\theta^2, \sigma_\mu^2, | R_{ij}, \tilde{y}_{ij}, \tilde{x}_i, j=1, \ldots, w_{ij}; \quad i=1, \ldots, N) = \prod_{i=1}^{N} G_i \tag{12-10}$$

where:

$$G_i = p_i r_i + q_i s_i \tag{12-11}$$

$$\text{(a)} \quad p_i \equiv 1-F\left[\phi_i \sum_{j=1}^{w_i} R_{ij} - \phi_i \sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij}; 0, d_i\sigma_\varepsilon^2 + w_i\phi_i^2\sigma_\theta^2\right]$$

$$\text{(b)} \quad r_i \equiv f^{w_i}\left[R_{i1} - \frac{n_i}{d_i}\tilde{m}'\tilde{x}_i, \ldots, R_{iw_i} - \frac{n_i}{d_i}\tilde{m}'\tilde{x}_i; 0, \ldots, 0, \Sigma_i\right] \tag{12-12}$$

(c) $$q_i \equiv 1-F\left[\sum_{j=1}^{w_i} R_{ij} + (\phi_i-1)\sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij} - n_i\tilde{m}'\tilde{x}_i; 0, n_i\sigma_\mu^2+(d_i-w_i)\sigma_\varepsilon^2\right]$$

(d) $$s_i \equiv \prod_{j=1}^{w_i} f^1\left[R_{ij} - \tilde{t}'\tilde{y}_{ij};\ 0,\ \sigma_\varepsilon^2\right]$$

(e) Σ_i $\equiv$ a square matrix of dimension w_i, with all diagonal elements equal to $\sigma_\theta^2 + (n_i/d_i^2)\sigma_\mu^2$, and all off-diagonal elements equal to $(n_i/d_i^2)\sigma_\mu^2$.

Simplifications of equations (12-12b) and (12-12d) are included in Appendix E. The remainder of this section is devoted to a derivation of equations (12-10) throug (12-12).

Let the probability of any random event H be denoted by Pr(H), and let the probability density of any point h be denoted by p(h). Furthermore, let:

B_i represent the event that:

$$\sum_{j=1}^{d_i} \tilde{t}'\tilde{y}_{ij} + \sum_{j=1}^{d_i} \varepsilon_{ij} \leq n_i\tilde{m}'\tilde{x}_i + \lambda_i$$

$\overline{B}_i$ represent the complement of B_i

a_i represent the occurrence that ε_{ij} has the value $R_{ij} - \tilde{t}'\tilde{y}_{ij}$ for each $j = 1, 2, \ldots, w_i$.

c_i represent the occurrence that the sum of $\theta_{ij} + \frac{1}{d_i}\lambda_i$ has the value $R_{ij} - \frac{n_i}{d_i}\tilde{m}'\tilde{x}_i$ for each $j = 1, \ldots, w_i$.

Consider the probability (density) that the w_i firms observed in the i^{th} market have income levels $R_{i1}, \ldots, R_{iw_i}$, respectively. According to the model represented by equation (12-6), either: (i) the sum of the targets of all firms in the i^{th} market is smaller than the maximum which consumers are willing to contribute, and therefore R_{ij} equals the target level of income of the j^{th} firm, or (ii) the sum of the targets of all firms in the i^{th} market exceeds the maximum, and therefore R_{ij} equals a fraction of the maximum plus a random variable. Conditions (i) and (ii) exhaust all possibilities, and are mutually exclusive. Therefore:

$$p(R_{i1}, \ldots, R_{iw_i}) = p(a_i|B_i)Pr(B_i) + p(c_i|\overline{B}_i)Pr(\overline{B}_i)$$

By assumption, occurrences in one market are independent of occurrences in another market. Therefore:

$$(12\text{-}13) \qquad p(R_{i1}, \ldots, R_{iw_i}, \ldots, R_{N1}, \ldots, R_{Nw_N}) = \prod_{i=1}^{N} G_i$$

where:

$$(12\text{-}14) \qquad G_i \equiv p(a_i|B_i)Pr(B_i) + p(c_i|\overline{B}_i)Pr(\overline{B}_i)$$

The likelihood function, $L(\tilde{m}, \tilde{t}, \sigma_\varepsilon^2, \sigma_\theta^2, \sigma_\mu^2 | R_{ij}, \tilde{y}_{ij}, \tilde{x}_{ij}, j=1,\ldots,w_i; i=1,\ldots,N)$ has the mathematical form of equations (13) and (14). Therefore, maximization of the product $\prod_{i=1}^{N} G_i$ with respect to $\tilde{m}$, $\tilde{t}$, σ_ε^2, σ_θ^2, and σ_μ^2, will yield maximum likelihood estimates of these parameters.

The terms in equation (12-14) will now be specified. Consider the first product on the right hand side of that equation. $p(a_i|B_i)Pr(B_i) = [p(a_i \cap B_i)/Pr(B_i)][Pr(B_i)] = p(a_i \cap B_i)$. Similarly, $Pr(B_i|a_i)p(a_i) = p(a_i \cap B_i)$. Therefore:

$$(12\text{-}15) \qquad p(a_i|B_i)Pr(B_i) = Pr(B_i|a_i)p(a_i)$$

Consider the first term of the product on the right hand side of equation (12-15). Substituting the definitions of B_i and a_i, this term represents the following expression:

$$(12\text{-}16) \qquad Pr(B_i|a_i) = Pr\left[\sum_{j=1}^{d_i} \tilde{t}'\tilde{y}_{ij} + \sum_{j=1}^{d_i} \varepsilon_{ij} \leq n_{ij}\tilde{m}'\tilde{x}_i + \lambda_i \,\middle|\, R_{ij} = \tilde{t}'\tilde{y}_{ij} + \varepsilon_{ij};\ j=1,\ldots,w_i\right]$$

The condition (a_i) implies that:

$$(12\text{-}17) \qquad \Pr(B_i|a_i) = \Pr\left[\sum_{j=1}^{w_i} R_{ij} + \sum_{j=w_i+1}^{d_i} \tilde{t}'\tilde{y}_{ij} + \sum_{j=w_i+1}^{d_i} \varepsilon_{ij} \le n_i\tilde{m}'\tilde{x}_i + \lambda_i\right]$$

But equation (12-8) implies that:

$$(12\text{-}18) \qquad \sum_{j=w_i+1}^{d_i} \tilde{y}_{ij} = (\phi_i - 1)\sum_{j=1}^{w_i} \tilde{y}_{ij}$$

Therefore:

$$(12\text{-}19) \qquad \sum_{j=w_i+1}^{d_i} \tilde{t}'\tilde{y}_{ij} = (\phi_i - 1)\sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij}$$

Substituting equation (12-19) into equation (12-17) and rearranging implies:

$$(12\text{-}20) \qquad \Pr(B_i|a_i) = \Pr\left[\sum_{j=1}^{w_i} R_{ij} + (\phi_i - 1)\sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij} - n_i\tilde{m}'\tilde{x}_i \le \lambda_i - \sum_{j=w_i+1}^{d_i} \varepsilon_{ij}\right]$$

But by assumption (12-9), λ_i and the ε_{ij}'s are independent and normally distributed. Therefore:

$$(12\text{-}21) \quad \Pr(B_i|a_i) = 1 - F\left[\sum_{j=1}^{w_i} R_{ij} + (\phi_i - 1)\sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij} - n_i\tilde{m}'\tilde{x}_i \,;\, 0,\, n_i\sigma_\mu^{\,2} + (d_i - w_i)\sigma_\varepsilon^{\,2}\right]$$

Now consider the second term in the product on the right hand side of equation (12-15). By assumption (12-9), the ε_{ij}'s are independent and identically distributed normal random variables. Therefore:

$$(12\text{-}22) \qquad p(a_i) = \prod_{j=1}^{w_i} f^1\left[R_{ij} - \tilde{t}'\tilde{y}_{ij};\, 0, \sigma_\varepsilon^{\,2}\right]$$

Now consider the second product on the right hand side of equation (12-14). Employing the same reasoning as that of the derivation of equation (12-14), it can be shown that:

$$(12\text{-}23) \quad p(c_i|\overline{B}_i)\Pr(\overline{B}_i) = \Pr(\overline{B}_i|c_i)p(c_i)$$

Consider the first term in the product on the right hand side of equation (12-23). Substituting the definitions of $\bar{B}_i$ and c_i, this term represents the following expression.

$$\Pr(\bar{B}_i|c_i)=\Pr\left[\sum_{j=1}^{d_i}\tilde{t}'\tilde{y}_{ij}+\sum_{j=1}^{d_i}\varepsilon_{ij} > n_i\tilde{m}'\tilde{x}_i+\lambda_i \,\middle|\, \theta_{ij}=R_{ij}-\frac{1}{d_i}[n_i\tilde{m}'\tilde{x}_i+\lambda_i];j=1,\ldots,w_i\right]$$

Given the condition c_i, it must be true that:

$$\frac{w_i}{d_i}\lambda_i = \sum_{j=1}^{w_i}R_{ij} - \frac{w_i}{d_i}n_i\tilde{m}'\tilde{x}_i - \sum_{j=1}^{w_i}\theta_{ij}$$

Therefore:

$$\Pr(\bar{B}_i|c_i)=\Pr\left[\sum_{j=1}^{d_i}\tilde{t}'\tilde{y}_{ij}+\sum_{j=1}^{d_i}\varepsilon_{ij} > n_i\tilde{m}'\tilde{x}_i+\frac{d_i}{w_i}\sum_{j=1}^{w_i}R_{ij} - n_i\tilde{m}'\tilde{x}_i - \frac{d_i}{w_i}\sum_{j=1}^{w_i}\theta_{ij}\right]$$

Substituting equation (12-19) and rearranging, this implies the following.

$$(12\text{-}24)\qquad \Pr(\bar{B}_i|c_i) = \Pr\left[\sum_{j=1}^{d_i}\varepsilon_{ij} + \phi_i\sum_{j=1}^{w_i}\theta_{ij} > \phi_i\sum_{j=1}^{w_i}R_{ij} - \phi_i\sum_{j=1}^{w_i}\tilde{t}'\tilde{y}_{ij}\right]$$

By assumption (12-9), the ε_{ij}'s and θ_{ij}'s are independent and normally distributed. Therefore:

$$(12\text{-}25)\qquad \Pr(\bar{B}_i|c_i) = 1-F\left[\phi_i\sum_{j=1}^{w_i}R_{ij} - \phi_i\sum_{j=1}^{w_i}\tilde{t}'\tilde{y}_{ij}\ ;\ 0, d_i\sigma_\varepsilon^2 + w_i\phi_i^2\sigma_\theta^2\right]$$

Finally, consider the second term in the product on the right hand side of equation (12-23). By definition of c_i, this term represents the following expression.

$$p(c_i) = p\left[\theta_{ij} + \frac{1}{d_i}\lambda_i = R_{ij} - \frac{n_i}{d_i}\tilde{m}'\tilde{x}_i\ ;\ j=1,\ldots,w_i\right]$$

Let:

$$\gamma_{ij} \equiv \theta_{ij} + \frac{1}{d_i}\lambda_i;\ j=1,\ \ldots,\ w_i$$

Since the θ_{ij}'s and λ_i are independent and normally distributed, the γ_{ij}'s are jointly normally distributed with mean zero and covariance represented by a matrix Σ_i of dimension $w_i \times w_i$, the diagonal elements of which equal $\sigma_\theta^2 + (n_i/d_i^2)\sigma_\mu^2$, and off-diagonal elements of which equal $(n_i/d_i^2)\sigma_\mu^2$.

Therefore:

$$(12\text{-}26)\quad p(c_i) = f^{w_i}\left[R_{i1} - \frac{n_i}{d_i}\tilde{m}'\tilde{x}_i, \ldots, R_{iw_i} - \frac{n_i}{d_i}\tilde{m}'\tilde{x}_i \; ; 0, \ldots, 0, \Sigma_i\right]$$

Summarizing the results of equations (12-13) through (12-15) and (12-21) through (12-26), the likelihood function may be expressed as in equations (12-10) through (12-12).

ILLUSTRATION OF THE TARGET INCOME MODEL

As an illustration of the target income model proposed above, we present an application of that model to the market for physicians' services. Specifically, it is assumed that each physician in a market determines the quantity of services to provide (or a price-quantity pair) in order to earn some target level of profits. The level of any physician's target is assumed to depend (in a manner specified by equation (12-1)) upon relevant values of exogenous variables such as the number of children in the physician's family, the average income level of the community in which he works, whether he is affiliated with a medical school, and the number of years of post-medical school training required for his specialty. It is further assumed that the maximum amount which any consumer is willing to contribute to physicians' salaries depends (in a manner specified by equation (12-4)) upon exogenous variables such as the consumer's income, the number of children and the number of elderly in the consumer's family, insurance coverage, and the consumer's race.

Under the assumptions enumerated above, the parameters of equations (12-1), (12-5), and (12-6) are estimated with data from the 1975 HCFA-NORC Survey.[6] These data include measures of income and various characteristics of 877 physicians in 30 SMSA'a (or counties) throughout the U.S. (Each SMSA was assumed to represent a separate market for physicians' services.)

A Fletcher-Powell minimization routine was employed to determine the values of the parameters $\tilde{m}$, $\tilde{t}$, σ_ε^2, σ_μ^2, and σ_θ^2 that maximize the likelihood function

(12-10).[7]

The results of the estimation are summarized in Table 12-1. Three separate sets of estimates are reported. Model 1 assumes that both a physician's target and the maximum which any consumer is willing to spend are totally independent of exogenous variables. That is, both targets and maxima are purely random numbers. Model 2 assumes that the target and the maximum expenditure level each depend upon a number of exogenous variables. Model 3 is a simplified version of model 2, which includes only those variables of model 2 which have coefficients significantly different from zero at the 90% confidence level.

Dependent and independent variables are defined as in Chapter 11. The variables are scaled so that the target level of income is measured in thousands of dollars, and the maximum contribution per consumer toward physicians' incomes is measured in dollars. All financial variables were deflated by a local cost of living index.

The estimates of model 1 suggest an average target level of income of approximately $70,000. Since the average level of realized income in the sample equaled $55,077, it is apparent that some physicians' goals must have been frustrated. Consumers could be expected on average to balk at contributing more than $49.60 to the annual income of physicians in the 5 specialty classes.

The parameter estimates of model 2 suggest that a physician's target level of income: (i) increases by $10,000 for each additional year spent in post medical school training, (ii) increases by $15,000 per $1,000 increase in the average income level of the community, and (ignoring significance tests), (iii) increases by $3,000 per child in his family, and (iv) is $12,600 smaller for physicians who are affiliated with a medical school faculty. Note that one cannot with reasonable confidence reject the hypotheses that number of children and faculty affiliation have no effects upon the target. The maximum per capita

Table 12-1

Parameter Estimates and T-Statistics: Three Models of Physician Income Determination

	Model 1	Model 2	Model 3
PHYSICIAN'S TARGET INCOME [equation (1)]			
constant	69.96 (22.48)	-42.76 (-1.63)	-31.82 (-1.22)
no. yrs. training		10.00 (2.95)	8.30 (2.77)
community per capita income		15.64 (3.14)	15.50 (2.97)
no. of children in family		2.89 (0.83)	
faculty affiliation		-12.58 (-0.91)	
σ_{ε}^2	3474	3046	2972
CONSUMERS' MAXIMUM PER CAPITA CONTRIBUTION TO INCOME [equation (5)]			
constant	49.64 (22.18)	100.05 (1.79)	89.23 (3.71)
income		14.55 (3.52)	14.57 (4.00)
% under 15		-4.47 (-3.05)	-4.08 (-3.76)
% without insurance		-0.42 (-0.89)	
% minority		0.27 (1.02)	
% over 65		0.03 (0.01)	
σ_{μ}^2	175	61	78
σ_{θ}^2	675	676	675
Log (Likelihood):	-4218.58	-4202.53	-4204.06

Table 12-2

Estimated Probability That Targets Can Be Achieved

SMSA	Model 1	Model 2	Model 3
Birmingham, Al.	.22	.22	.13
Fresno, Cal.	.34	.11	.20
Los Angeles	.00	.00	.00
San Diego	.01	.00	.03
Mesa, Co.	.06	.03	.05
New Britain, Ct.	.17	.05	.03
Springfield, Ma.	.38	.09	.28
Orlando, Fa.	.41	.12	.32
Atlanta	.18	.01	.05
Chicago	.08	.00	.00
St. Louis	.42	.13	.15
Morris Co., Ka.	.55	.59	.65
Topeka, Ka.	.51	.41	.49
New Orleans	.11	.00	.00
Flint, Mi.	.74	.10	.21
Detroit	.63	.00	.02
Carroll, Mo.	.59	.76	.73
Great Falls, Mont.	.34	.16	.27
Newark	.03	.01	.01
New York	.00	.15	.09
Johnston Co., N.C.	.66	.65	.72
Wilkes, N.C.	.70	.72	.72
Columbus, Oh.	.48	.32	.37
Armstrong Co., Pa.	.70	.72	.76
Reading, Pa.	.33	.49	.66
Philadelphia	.04	.24	.11
Florence, S.C.	.41	.25	.25
Wichita Falls, Tx.	.43	.47	.55
Chittenden Co., Vt.	.14	.00	.03
Marion, W. Va.	.53	.67	.73

amount consumers are willing to contribute to the profit of doctors of the 5 specialties: (i) increases by \$14.6 per \$1,000 of per capita income, (ii) decreases by \$4.5 per 1% of the population composed of children, and (ignoring significance levels) (iii) decreases by \$.4 per 1% increase in the portion of the population without medical insurance, (iv) increases \$.3 per 1% increase in the portion of the population who are minorities, and (v) is not affected by the fraction of the population composed of senior citizens. One cannot with reasonable confidence reject the hypotheses that percent without insurance, percent minority, and percent senior citizens have no effects upon the maximum per capita expenditure level.

The estimated values of the coefficients and variances may be employed with observations of exogenous variables in any market to estimate the likelihood that physicians in the market can achieve their target levels of income (i.e., the probability that the sum of all targets is smaller than the sum of the aggregate of consumer maxima):

$$\Pr\left[\sum_{i=1}^{d_i} T_i^* < M_i\right] = \Pr\left[\sum_{j=1}^{d_i} \varepsilon_{ij} - \lambda_i < n_i \tilde{m}'\tilde{x}_i - \phi_i \sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij}\right]$$

But by assumption $\sum_{j=1}^{d_i} \varepsilon_{ij} - \lambda_i$ is a normally distributed random variable of mean zero and variance equal to $(n_i\sigma_\mu{}^2 + d_i\sigma_\varepsilon{}^2)$. Therefore:

$$\text{(12-27)} \qquad \Pr\left[\sum_{i=1}^{d_i} T_i^* < M_i\right] = F_{std}\left[\frac{n_i \tilde{m}'\tilde{x}_i - \phi_i \sum_{j=1}^{w_i} \tilde{t}'\tilde{y}_{ij}}{(n_i\sigma_\mu{}^2 + d_i\sigma_\varepsilon{}^2)^{1/2}}\right]$$

where $F_{std}(\cdot)$ denotes the value of the cumulative standard normal distribution function.

Equation (12-27) was applied with the estimated coefficients of each of the three models to the markets included in the sample. The results of this exercise are reported in Table 12-2. The small number of markets in which physicians are estimated to have a reasonable chance of achieving their targets casts some doubt upon the applicability of target income pricing models to the physicians' market.

SUMMARY AND CONCLUSION

An empirically estimable model of firm and market equilibrium when firms seek target levels of income rather than maximum profit has been presented. This model allows estimation of both the determinants of a firm's target level of income and the determinants of an upper bound to consumers' expenditures. Furthermore, the parameter estimates may be employed to estimate the probability that the existing firms in a market can succeed in achieving their targets.

The determinants of the target levels of income of physicians in 30 American cities were estimated. It was found that the likelihood that physicians can actually achieve these targets was quite low in most of those cities.

FOOTNOTES TO CHAPTER 12

[1] This assumption could be justified by the stronger assumption that suppliers never compete on price. This, however, would imply the potential existence of permanent excess demand. A more plausible assumption is that market price adjusts to equilibrate supply and demand, except that (by mutual agreement) firms never lower price below the level at which aggregate demand has unit elasticity. This is equivalent to the assumption that firms compete on price so long as all targets can be achieved. When the aggregate of targets exceeds the maximum potential expenditure, firms eschew further price competition.

[2] If firms as a group extract maximum expenditures when all targets cannot be achieved, then equilibrium price in this state will be that price at which aggregate demand has unit elasticity.

[3] It is assumed that any consumer's maximum willingness to pay is independent of the consumption, or willingness to pay, of all other consumers.

[4] If firms seek target levels of gross income, let α equal 1.

[5] The assumption that the μ_{ij}'s are independent across firms may be subject to question, for it can be reasonably expected that if one firm receives a greater share of the revenues, then some other firm(s) will receive a smaller share. Since the model is designed to be estimated with cross sectional data, estimation of the covariance of revenues between any pair of firms would be impossible. An alternative assumption might be that the covariance between every revenue pair (within one market) is constant. In the opinion of the author, the allowance of nonzero covariance does not improve the model sufficiently to justify the additional estimation problems caused by relaxation of this assumption.

Note that the specification of error structure implies that in markets in states of "excess supply," the sum of the firms' revenues can differ slightly from the maximum expenditure level.

[6] See Sloan, Cromwell, and Mitchell (1978) for a detailed description of this data source.

[7] In all cases, initial values of the coefficients $\tilde{t}$ were obtained by regressing income (R_{ij}) upon the vector of target determining variables ($\tilde{y}_{ij}$) (as if equations (6a) and (1) held in all markets). Likewise, initial values of the coefficients $\tilde{m}$ were obtained by regressing income (R_{ij}) upon the vector of maximum determining variables divided by the number of physicians ($n_i \tilde{x}_i / d_i$)(as if equations (6b) and (5) held in all markets.

The final estimates of the variances σ_ε^2, σ_μ^2, and σ_θ^2 from model 1 were employed as initial estimates of those parameters for models 2 and 3. Initial estimates of the variances for model 1 were chosen through the following sequence of calculations.

The estimated variance of the regression of R_{ij} upon $\tilde{y}_{ij}$ was employed as the initial estimate of σ_ε^2.

Next, the initial estimate of σ_μ^2 was chosen to be just large enough that, at the initial starting point, the following condition was satisfied in each market.

$$.0013 \leq \Pr\left[\sum_{j=1}^{d_i} \tilde{t}'\tilde{y}_{ij} + \sum_{j=1}^{d_i} \varepsilon_{ij} \leq n_i\tilde{m}'\tilde{x}_i + \lambda_i \,\middle|\, R_{ij} = \tilde{t}'\tilde{y}_{ij} + \varepsilon_{ij};\ j=1,\ldots,w_i\right] \leq .9987$$

That is, $\sigma_\mu{}^2$ was chosen just large enough that (given that observed incomes equal targets) $\sum_{j=1}^{d_i} \varepsilon_{ij} - \lambda_i$ is within 3 standard deviations of $[n_i\tilde{m}'\tilde{x}_i - \sum_{j=1}^{d_i} \tilde{t}'\tilde{y}_{ij}]$ for every i.

Similarly, the initial estimate of $\sigma_\theta{}^2$ was then chosen to be just large enough that, at the initial starting point, the following condition was satisfied in each market.

$$.0013 \leq \Pr\left[\sum_{j=1}^{d_i} \tilde{t}'\tilde{y}_{ij} + \sum_{j=1}^{d_i} \varepsilon_{ij} > n_i\tilde{m}'\tilde{x}_i + \lambda_i \,\middle|\, \theta_{ij} = R_{ij} - \frac{1}{d_i}[n_i\tilde{m}'\tilde{x}_i + \lambda_i];j=1,\ldots,w_i\right] \leq .9987$$

That is, $\sigma_\mu{}^2$ was chosen just large enough that (given that observed incomes equal the physicians' shares of the maximum revenue), $\sum_{j=1}^{d_i} \varepsilon_{ij} - \lambda_i$ is within 3 standard deviations of $[n_i\tilde{m}'\tilde{x}_i - \sum_{j=1}^{d_i} \tilde{t}'\tilde{y}_{ij}]$ for every i.

Chapter 13

Models of Physician Behavior: Quality as a Decision Variable

George Sweeney

INTRODUCTION

Assume a physician can choose both the price charged per unit of service, (P), and the level of quality (or amenities, or advice, whether bad or good) supplied per unit of service, (X).

Let Q represent the quantity of one physician's services. The quantity of services demanded from one physician is assumed to be a function of the price, the level of X, and the value of a vector of exogenous variables, (E), such as income of patients, insurance coverage, and age of patients. That is:

$$Q = D(P,X,E)$$

Let F(Q,X,E) represent the inverse demand function.

Assume that the cost of providing Q units of service, each with a level of quality equal to X is represented by the function C(Q,X,W), where W represents a vector of exogenous cost determining factors, such as pieces of equipment and labor.

Assume that the doctor chooses price (P) and quality (X) to maximize his profits.

In sections A through E, we analyze this problem in completely general terms, assuming nothing about the characteristics of the demand and cost functions. Specific assumptions about the characteristics of the demand function are made in section F, and the implications of these assumptions are derived throughout the remaining sections.

PROFIT MAXIMIZATION PROBLEM: DERIVATIONS

A. Profit Maximization Problem

$$\max_{Q,X} \quad QF(Q,X,E) - C(Q,X,W)$$

$$\text{s.t.} \quad X \geq 0, \; Q \geq 0$$

B. F.O.N.C.

$$(13\text{-}1) \quad \frac{\partial \pi}{\partial Q} = 0 \quad : \quad F + QF_Q - C_Q = 0$$

$$(13\text{-}2) \quad \frac{\partial \pi}{\partial X} \leq 0 \quad : \quad QF_X - C_X \leq 0$$

C. S.O.N.C.

$$(13\text{-}3)\quad \begin{bmatrix} 2F_Q + QF_{QQ} - C_{QQ} & F_X + QF_{QX} - C_{QX} \\ F_X + QF_{QX} - C_{QX} & QF_{XX} - C_{XX} \end{bmatrix} \quad \text{negative definite}$$

requires:

$$(13\text{-}4)\quad 2F_Q + QF_{QQ} - C_{QQ} < 0$$

$$(13\text{-}5)\quad QF_{XX} - C_{XX} < 0$$

D. Efficient X Locus

Define "efficient - X" locus as locus of points (Q,X) which satisfy:

$$(13\text{-}6)\quad \frac{C_X}{Q} = F_X$$

totally differentiate eqn (13-6):

$$(13\text{-}7)\quad \left[\frac{QC_{XQ} - C_X}{Q^2} - F_{XQ}\right] dQ + \left[\frac{C_{XX}}{Q} - F_{XX}\right] dX - F_{XE} dE + \frac{C_{XW}}{Q} dW = 0$$

slope of efficient X locus:

$$(13\text{-}8)\quad \left.\frac{\partial X}{\partial Q}\right|_{\text{eff } X} = \frac{QF_{XQ} - (C_{XQ} - C_X/Q)}{C_{XX} - QF_{XX}}$$

note by S.O.N.C. that the denominator is positive.

E. Effect of Changes in Exogenous Factors

Effect upon efficient - X locus (from eqn (13-7):

$$(13\text{-}9)\quad \left.\frac{\partial X}{\partial E}\right|_{Q,\text{ eff } X} = \frac{QF_{XE}}{C_{XX} - QF_{XX}}$$

$$(13\text{-}10)\quad \left.\frac{\partial X}{\partial W}\right|_{Q,\text{ eff } X} = \frac{-C_{XW}}{C_{XX} - QF_{XX}}$$

effect upon optimal Q, X:

(13-11) $\frac{\partial Q^*}{\partial E} = \frac{1}{\Delta}[-(F_E + QF_{QE})(QF_{XX} - C_{XX}) + QF_{XE}(F_X + QF_{QX} - C_{QX})]$

(13-12) $-\frac{\partial X^*}{\partial E} = \frac{1}{\Delta}[(F_E + QF_{QE})(F_X + QF_{QX} - C_{QX}) - QF_{XE}(QF_{QQ} + 2F_Q - C_{QQ})]$

(13-13) $\frac{\partial Q^*}{\partial W} = \frac{1}{\Delta}[C_{QW}(QF_{XX} - C_{XX}) - C_{XW}(F_X + QF_{QX} - C_{QX})]$

(13-14) $\frac{\partial X^*}{\partial W} = \frac{1}{\Delta}[-C_{QW}(F_X + QF_{QX} - C_{QX}) + C_{XW}(QF_{QQ} + 2F_Q - C_{QQ})]$

where:

(13-15) $\Delta \equiv (2F_Q + QF_{QQ} - C_{QQ})(QF_{XX} - C_{XX}) - (F_X + QF_{QX} - C_{QX})^2 > 0$

effect upon optimal price:

(13-16) $\frac{\partial P^*}{\partial E} = F_E + F_Q\frac{\partial Q^*}{\partial E} + F_X\frac{\partial X^*}{\partial E}$

(13-17 $\frac{\partial P^*}{\partial W} = F_Q\frac{\partial Q^*}{\partial W} + F_X\frac{\partial X^*}{\partial W}$

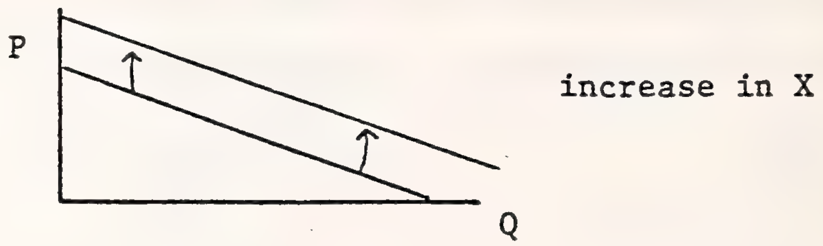
F. Derivation of Physician Demand Function

Assume that each doctor in an area serves $\tilde{R}$ identical patients.

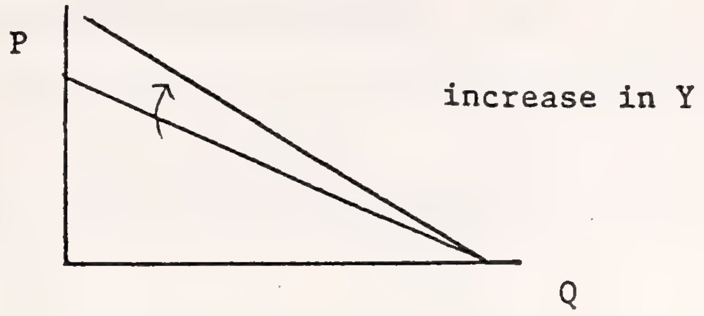
Each patient's demand function depends upon the following variables:

X ("quality"), Y ("income"), I ("insurance"), A ("age")

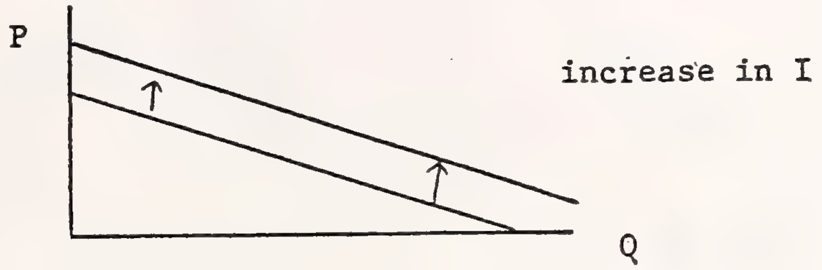
Assume that an increase in X shifts patient's inverse demand upward in a parallel direction:



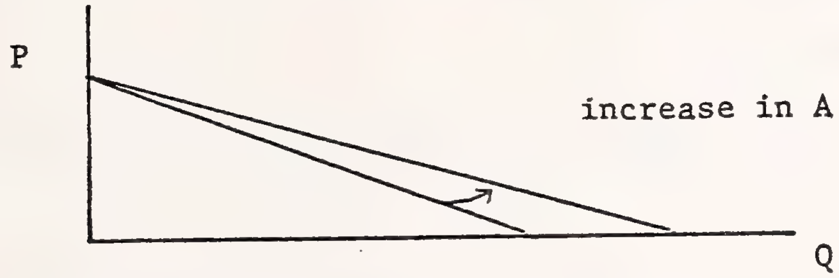
Increase in Y rotates patient's inverse demand about the Q-axis intercept:



Increase in I shifts patient's inverse demand upward in a parallel direction:



Increase in A rotates inverse demand about the P axis intercept:



Thus an individual consumer's inverse demand function may be written as follows:

$$P \equiv f(Q, X, Y, I, A)$$

$$= \left[1 + h(Y)\right]\left[f(\frac{Q}{a(A)}, X°, Y°, I°, A°) + g(I) + r(X)\right]$$

where:

$X°$, $Y°$, $I°$, $A°$ are constants

and

$h(Y) \geq 0$ $\qquad$ $h'(Y) \geq 0$

$a(A) > 0$ $\qquad$ $a'(A) \geq 0$

$g(I) \geq 0$ $\qquad$ $g'(I) \geq 0$

$r(x) \geq 0$ $\qquad$ $r'(X) \geq 0$

Assuming $\tilde{R}$ identical patients, the inverse demand function facing an individual physician may be represented as follows:

(13-18) $$P \equiv F(Q, X, Y, I, A, \tilde{R})$$

$$= [1 + h(Y)][f(\frac{Q}{\tilde{R}a(A)}, X°, Y°, I°) + g(I) + r(X)]$$

let

(13-19) $$R \equiv \tilde{R}a(A)$$

Substituting this definition:

(13-20) $$F(Q, X, Y, I, A, \tilde{R}) = [1 + h(Y)][f(\frac{Q}{R}, X°, Y°, I°, A°) + g(I) + r(X)]$$

Thus for any endogenous variable S:

(13-21)

(a) $$\frac{\partial S}{\partial \tilde{R}} = \frac{\partial S}{\partial R} \cdot a(A)$$

(b) $$\frac{\partial S}{\partial A} = \frac{\partial S}{\partial R} \cdot \tilde{R}a'(A)$$

Finally, let:

(13-22) $$f_\circ(Q/R) \equiv f(Q/R, X°, Y°, I°, A°)$$

then:

(13-23) $$F(Q, X, Y, I, A, \tilde{R}) = [1 + h(Y)][f_\circ(Q/R) + g(I) + r(X)]$$

G. Properties of Efficient - X Locus, Assuming Demand Function of Section F

$F_{QX} = 0$; therefore, eqn (13-8) implies:

(13-24a) $$\left.\frac{\partial X}{\partial Q}\right|_{\text{eff } X} = -\frac{C_{XQ} - \frac{C_X}{Q}}{C_{XX} - QF_{XX}}$$

or (13-24b) $$\left.\frac{\partial X}{\partial Q}\right|_{\text{eff } X} = \frac{-\frac{\partial}{\partial X}(C_Q - \frac{C}{Q})}{C_{XX} - QF_{XX}} = \frac{\frac{\partial AC}{\partial X} - \frac{\partial MC}{\partial X}}{C_{XX} - QF_{XX}}$$

Thus:

efficient level of X:

(a) increases with A if an increase in X increases AC more than MC

(b) is independent of Q if an increase in X affects AC and MC the same

(c) Decreases with Q if an increase in X increases AC less than MC

ANALYSIS OF CHANGES IN EXOGENOUS FACTORS

Assumption a:

We assume that in the neighborhood of the profit maximizing quantity Q^*, MR is a decreasing function of Q. That is, we assume:

$$2F_Q + F_{QQ} < 0$$

or,

$$2f_o' + \frac{Q}{R}f_o'' < 0$$

Assumption b:

We assume that in the neighborhood of the equilibrium quantity Q^*:

$$C_{QQ} \geq 0$$

lemma

Let D(P) represent any demand function and F(Q) represent its inverse. Let $\varepsilon(P)$ represent the elasticity of demand at price P. (defined as a positive number).

The following characteristics of a demand function are equivalent

(1) $\dfrac{F_{QQ}}{-F_Q} > \dfrac{1}{Q}$

(2) $\left|\dfrac{D_P}{D}\right|$ decreases with increased P

(3) $\dfrac{\partial \varepsilon}{\partial P} \cdot \dfrac{P}{\varepsilon} < 1$

proof

(1) and (2):

$$\frac{\partial}{\partial P}\left|\frac{D_P}{D}\right| = \frac{\partial}{\partial P}\left(\frac{-D_P}{D}\right) = \frac{-DD_{PP} + D_P^2}{D^2}$$

therefore: condition (2) is equivalent to:

$$D_P^2 - DD_{PP} < 0$$

Condition (1) implies:

$$F_Q + QF_{QQ} > 0$$

This requires:

$$\frac{1}{D_P} + \frac{D(-D_{PP})}{D_P^{\,3}} > 0$$

or

$$\frac{D_P^{\,2} - DD_{PP}}{D_P^{\,3}} > 0$$

Since $D_P^{\,3} < 0$, condition (1) is equivalent to:

$$D_P^{\,2} - DD_{PP} < 0$$

(2) and (3):

$$\varepsilon = \frac{-D_P}{D} \cdot P, \quad \frac{P}{\varepsilon} = \frac{D}{-D_P}$$

$$\frac{\partial\varepsilon}{\partial P} = \frac{-D_P}{D} - \frac{DD_{PP} - D_P^{\,2}}{D^2}$$

$$\frac{\partial\varepsilon}{\partial P} \cdot \frac{P}{\varepsilon} = 1 + \frac{D_P^{\,2} - DD_{PP}}{(-D_P)D}$$

Therefore:

$D_P^{\,2} - DD_{PP} < 0$ requires that:

$$\frac{\partial\varepsilon}{\partial P} \cdot \frac{P}{\varepsilon} < 1$$

Q.E.D.

Note:

It will be convenient to classify demand functions according to whether condition (1) is satisfied.

For the exponential demand function:

$$D(P) = c_o e^{c_1 P}$$

$$\frac{F_{QQ}}{-F_Q} \quad \text{equals } 1/Q$$

We shall call all demand functions for which inequality (1) is satisfied as "relatively more convex than the exponential." Likewise we shall call all demand functions for which inequality (1) is not satisfied as "relatively less convex than the exponential."

Note that by condition (1), the linear demand function is in the class of "relatively less convex" functions.

By condition (3), the constant elasticity demand function is in the class of "relatively more convex" functions.

Thus to summarize notation:

"relatively less convex": $F_Q + QF_{QQ} < 0$

exponential : $F_Q + QF_{QQ} = 0$

"relatively more convex": $F_Q + QF_{QQ} > 0$

H. Effects of an Increase in R

lemma

A change in R has no effect upon the efficient X locus.

proof:

By eqn (13-9) and $F_{XR} = 0$:

$$\left.\frac{\partial X}{\partial R}\right|_{Q,\ \text{eff } X} = 0 \tag{13-25}$$

theorem H1 (effect upon output)

An increase in R results in an increased equilibrium output Q^*.

proof to thm H1

by eqn (13-11) and $F_{XR} = 0$:

$$\frac{\partial Q^*}{\partial R} = \frac{1}{\Delta}\{-(F_R + QF_{QR})(QF_{XX} - C_{XX})\} \tag{13-26}$$

but

$$F_R = -\left(\frac{Q}{R}\right)F_Q \tag{13-27a}$$

$$F_{QR} = -\frac{1}{R}(F_Q + QF_{QQ}) \tag{13-27b}$$

$$F_R + QF_{QR} = -\frac{Q}{R}(2F_Q + QF_{QQ}) > 0 \quad \text{by assump. a} \tag{13-27c}$$

S.O.N.C. requires that $\Delta > 0$ and $C_{XX} - CF_{XX} > 0$

therefore,

$$\frac{\partial Q^*}{\partial R} > 0$$

theorem H2 (effect upon X)

$$\operatorname{sgn}\left[\frac{\partial X^*}{\partial R}\right] = \operatorname{sgn}\left[\frac{\partial}{\partial X}\left(\frac{C}{Q} - C_Q\right)\right]$$

proof:

By eqn (13-12), $F_{XR} = 0$, and $F_{QX} = 0$

$$\frac{\partial X^*}{\partial R} = \frac{1}{\Delta}[(F_R + QF_{QR})(F_X - C_{QX})]$$

By eqn (13-2):

$$\frac{\partial X^*}{\partial R} = \frac{1}{\Delta}(F_R + QF_{QR})\left(\frac{C_X}{Q} - C_{QX}\right) \tag{13-28}$$

But as shown in proof to thm H1:

$$F_R + QF_{QR} > 0$$

therefore:

$$\text{sgn}\left[\frac{\partial X^*}{\partial R}\right] = \text{sgn}\left[\frac{C_X}{Q} - C_{QX}\right]$$

Q.E.D.

Comment:

Theorem H2 can also be derived by examination of the efficient X locus, since that locus is not affected by changes in R. By thm H1, $\partial Q^*/\partial R > 0$.

Therefore:

$$\text{sgn}\left[\frac{\partial X}{\partial R}\right] = \text{sgn}\left[\left.\frac{\partial X}{\partial Q}\right|_{\text{eff } X}\right]$$

by eqn (13-25):

$$\text{sgn}\left[\frac{\partial X}{\partial R}\right] = \text{sgn}\left[\frac{\partial}{\partial X}\left(\frac{C}{Q} - C_Q\right)\right]$$

theorem H3 (effect upon price)

The possible signs of $\partial P^*/\partial R$ are summarized below.

	$\frac{\partial AC}{\partial X} > \frac{\partial MC}{\partial X}$	$\frac{\partial A}{\partial X} = \frac{\partial MC}{\partial X}$	$\frac{\partial AC}{\partial X} < \frac{\partial MC}{\partial X}$
D less convex than exp.	+	+	?
D more convex than exp.	?	+	?

(1) If $\frac{\partial AC}{\partial X} > \frac{\partial MC}{\partial X}$ then:

(a) the likelihood of a perverse effect ($\frac{\partial P^*}{\partial R} < 0$) is greater, the greater the convexity of the demand function and the greater the difference between $\partial AC/\partial X$ and $\partial MC/\partial X$.

(b) Specifically, with a constant elasticity demand function, a sufficient condition for the normal effect ($\partial P^*/\partial R > 0$) is that:

$$\frac{\partial AC}{\partial X} < \varepsilon\frac{\partial MC}{\partial X}$$

(2) If $\frac{\partial AC}{\partial X} < \frac{\partial MC}{\partial X}$ then:

the likelihood of a perverse effect is greater, the less convex (or more concave) the demand function, and the greater the difference between $\partial AC/\partial X$ and $\partial MC/\partial X$

proof:

By eqns (13-16), (13-11), (13-12), and $F_{XR} = 0$:

$$\frac{\partial P^*}{\partial R} = F_R + \frac{1}{\Delta}[F_R + QF_{QR}][-F_Q(QF_{XX} - C_{XX}) + F_X(F_X - C_{QX})]$$

by eqn (13-15):

$$\frac{\partial P^*}{\partial R} = \frac{1}{\Delta}\{[(2F_Q + QF_{QQ} - C_{QQ})(QF_{XX} - C_{XX}) - (F_X - C_{QX})^2]F_R +$$

$$[F_R + QF_{QR}][-F_Q(QF_{XX} - C_{XX}) + F_X(F_X - C_{QX})]\}$$

$$= \frac{1}{\Delta}\{(QF_{XX} - C_{XX})[F_R(2F_Q + QF_{QQ} - C_{QQ}) - F_Q(F_R + QF_{QR})] +$$

$$(F_X - C_{QX})[F_X(F_R + QF_{QR}) - F_R(F_X - C_{QX})]\}$$

but

$$F_R = \left(\frac{-Q}{R}\right)F_Q$$

$$F_{QR} = -\frac{1}{R}(F_Q + QF_{QQ})$$

Therefore: $F_R + QF_{QR} = -\frac{Q}{R}(2F_Q + QF_{QQ})$. Substituting these terms:

$$\frac{\partial P^*}{\partial R} = \frac{1}{\Delta}\left(\frac{Q}{R}\right)\{(QF_{XX} - C_{XX})(F_Q)[-(2F_Q + QF_{QQ} - C_{QQ}) + (2F_Q + QF_{QQ})] +$$

$$(F_X - C_{QX})[-F_X(2F_Q + QF_{QQ}) + F_Q(F_X - C_{QX})]\}$$

$$\frac{\partial P^*}{\partial R} = \frac{1}{\Delta}\left(\frac{Q}{R}\right)\{(QF_{XX} - C_{XX})(F_Q)(C_{QQ}) + (F_X - C_{QX})[-F_X(2F_Q + QF_{QQ}) + F_Q(F_X - C_{QX})]\}$$

Substituting F.O.N.C. (13-2):

$$\frac{\partial P^*}{\partial R} = \frac{1}{\Delta}\left(\frac{Q}{R}\right)\left\{(C_{XX} - QF_{XX})(-F_Q)(C_{QQ}) + \left(\frac{C_X}{Q} - C_{QX}\right)\left[-\frac{C_X}{Q}(2F_Q + QF_{QQ}) + F_Q\left(\frac{C_X}{Q} - C_{QX}\right)\right]\right\} \tag{13-29a}$$

or equivalently:

$$\frac{\partial P^*}{\partial R} = \frac{1}{\Delta}\left(\frac{Q}{R}\right)\left\{(C_{XX} - QF_{XX})(-F_Q)C_{QQ} + \left(\frac{C_X}{Q} - C_{QX}\right)\left[-(F_Q + QF_{QQ})\frac{C_X}{Q} + (-F_Q)C_{QX}\right]\right\} \tag{13-29b}$$

Note that S.O.N.C. condition (13-3) requires that Δ be positive. Similarly, S.O.N.C. (13-5) and assumption b imply that the first term in the braces is nonnegative.

If $\frac{C_X}{Q} - C_{QX} = 0$, then $\frac{\partial P^*}{\partial R} \geq 0$.

(1a):

If $\frac{C_X}{Q} - C_{QX} > 0$, and if $F_Q + QF_{QQ} < 0$,

then the second term in braces in eqn (13-29b) is also positive.

Therefore: $\partial P^*/\partial R > 0$.

Note that when $\frac{C_X}{Q} - C_{QX} > 0$, the possibility of a perverse effect increases (when $F_Q + QF_{QQ} > 0$) as both $(F_Q + QF_{QQ})$ and $(C_X/Q - C_{QX})$ increase.

(1b):

$$F_Q = \frac{1 + h}{R} f_o'(Q/R)$$

$$F_Q + QF_{QQ} = \frac{1 + h}{R} \left[f_o'(Q/R) + \frac{Q}{R} f_o''(Q/R)\right]$$

Consider the constant elasticity inverse dmd fntn:

$$f_o(q) = aq^{-\frac{1}{\varepsilon}}$$

In this case:

$$f_o'(Q/R) = -\frac{1}{\varepsilon} \frac{f_o}{Q/R}$$

$$f_o' + \frac{Q}{R} f_o'' = \frac{1}{\varepsilon^2} \frac{f_o}{Q/R}$$

Therefore, in this case, the second term in braces in equation (13-29b) reduces to:

$$\left(\frac{C_X}{Q} - C_{QX}\right)\left(\frac{1 + h}{R}\right)\left(\frac{f_o}{Q/R}\right)\left[-\frac{1}{\varepsilon^2} \frac{C_X}{Q} + \frac{1}{\varepsilon} C_{QX}\right]$$

$$= \left(\frac{C_X}{Q} - C_{QX}\right)\left(\frac{1 + h}{R}\right)\left(\frac{f_o}{Q/R}\right)\frac{1}{\varepsilon}\left[C_{QX} - \frac{1}{\varepsilon} \frac{C_X}{Q}\right]$$

This term is positive if:

$$\frac{C_X}{Q} < \varepsilon\, C_{QX}$$

and thus, it is sufficient for $\partial P^*/\partial R > 0$ that

$$\frac{C_X}{Q} < \varepsilon\, C_{QX}$$

(2):

When $C_X/Q - C_{QX} < 0$, assumption a assures that:

$$-\frac{C_X}{Q}(2F_Q + QF_{QQ}) + F_Q(\frac{C_X}{Q} - C_{QX}) > 0$$

Therefore, the second term in braces in eqn (29a) is negative. Note that the likelihood of a perverse effect increases as the magnitude of this term increases. That is, the likelihood of a perverse effect increases as $F_Q + QF_{QQ}$ becomes more negative and $\frac{C_X}{Q} - C_{QX}$ becomes more negative.

Q.E.D.

theorem H4 (effect upon physician's revenue)

(1) If $\partial AC/\partial X > \partial MC/\partial X$, then $\partial Rev/\partial R > 0$

(2) If $\partial AC/\partial X < \partial MC/\partial X$, then $\partial Rev/\partial R$ cannot be guaranteed to be positive. However, $\partial Rev/\partial R$ can be negative only if $\partial P^*/\partial R < 0$.

proof:

$$\frac{\partial Rev^*}{\partial R} = P^*\frac{\partial Q^*}{\partial R} + Q^*\frac{\partial P^*}{\partial R} \qquad (13\text{-}30)$$

but

$$\frac{\partial P^*}{\partial R} = F_R + F_Q\frac{\partial Q^*}{\partial R} + F_X\frac{\partial X^*}{\partial R}$$

Therefore:

$$\frac{\partial Rev^*}{\partial R} = (F + QF_Q)\frac{\partial Q^*}{\partial R} + Q^*F_X\frac{\partial X^*}{\partial R} + Q^*F_R \qquad (13\text{-}31)$$

(1) F.O.N.C. (13-1) requires that $F + QF_Q > 0$

$\partial Q^*/\partial R > 0$ by theorem H1

$F_R > 0$

$F_X > 0$

Therefore $\partial X^*/\partial R > 0$ is a sufficient condition that $\partial Rev^*/\partial R > 0$

By theorem H2, this condition is satisfied when

$\partial AC/\partial X > \partial MC/\partial X$.

(2) by theorem H1, $\partial Q^*/\partial R > 0$. Therefore, by eqn (13-30) in order that $\partial Rev^*/\partial R < 0$, it is necessary that $\partial P^*/\partial R < 0$.

theorem H5 (effect upon profits)

An increase in R results in increased profits.

proof:

If R increases, the physician's inverse demand curve rotates outward in a clockwise direction. This implies that at the very least, the physician could continue to serve the same no. of patients with the same level of X but at a higher price. This would result in greater revenue with no change in costs, and therefore greater profits.

I. Effects of an Increase in I

theorem I-1 (effect upon Q^*)

An increase in I results in increased equilibrium output Q^*.

proof:

By substitution into eqn (13-11):

$$\frac{\partial Q^*}{\partial I} = \frac{-1}{\Delta}(1 + h)g'(QF_{XX} - C_{XX}) \qquad (13\text{-}32)$$

which must be positive by S.O.N.C. (13-3) and (13-5)

theorem I-2 (effect upon X^*)

(1) if $\partial AC/\partial X > \partial MC/\partial X$ then $\partial X^*/\partial I > 0$

(2) if $\partial AC/\partial X < \partial MC/\partial X$ then $\partial X^*/\partial I < 0$

proof:

By substituting into eqn (13-12):

$$\frac{\partial x^*}{\partial I} = \frac{1}{\Delta}(1 + h)g'(F_X + QF_{QX} - C_{QX})$$

substituting eqns (13-2) and $F_{QX} = 0$:

$$(13\text{-}33)\quad \frac{\partial \bar{X}^*}{\partial I} = \frac{1}{\Delta}(1 + h)g'\left(\frac{C_X}{Q} - C_{QX}\right)$$

Q.E.D.

theorem I-3 (effect upon P^*)

The possible signs of $\partial P^*/\partial I$ are summarized below:

	$\partial AC/\partial X \geq \partial MC/\partial X$	$\partial AC/\partial X < \partial MC/\partial X$
D less convex than exp	+	?
D more convex than exp	?	?

(1) If $\partial AC/\partial X \geq \partial MC/\partial X$:

The likelihood of a perverse effect ($\partial P/\partial I < 0$) is greater, the more convex the demand curve and the smaller the difference between $\partial AC/\partial X$ and $\partial MC/\partial X$, and the smaller $\partial MC/\partial Q$.

For example, if $\partial AC/\partial X = \partial MC/\partial X$ and marginal cost is independent of output, then $\partial P^*/\partial I < 0$ for any demand function relatively more convex than the exponential.

(2) If $\partial AC/\partial X < \partial MC/\partial X$:

The likelihood of a perverse effect is greater, the more convex the demand function, and the greater the difference between $\partial AC/\partial X$ and $\partial MC/\partial X$, and the smaller $\partial MC/\partial Q$.

proof:

Equations (13-16), (13-32), and (13-33) and $F_I = (1+h)g'$ imply:

$$\frac{\partial P^*}{\partial I} = \frac{1 + h}{\Delta}\left\{g'(2F_Q + QF_{QQ} - C_{QQ})(QF_{XX} - C_{XX}) - g'\left(\frac{C_X}{Q} - C_{QX}\right)^2 - F_Q g'(QF_{XX} - C_{XX}) + \frac{C_X}{Q}g'\left(\frac{C_X}{Q} - C_{QX}\right)\right\}$$

or

$$(13\text{-}34)\quad \frac{\partial P^*}{\partial I} = \left(\frac{1+h}{\Delta}\right) g' \left\{ (QF_{XX} - C_{XX})(F_Q + QF_{QQ} - C_{QQ}) + \left(\frac{C_X}{Q} - C_{QX}\right) C_{QX} \right\}$$

(1) If $\frac{C_X}{Q} - C_{QX} > 0$, the second term in braces is positive.

By S.O.N.C. (13-5), the first term is positive whenever $(F_Q + QF_{QQ} - C_{QQ})$ is negative. This is insured if $F_Q + QF_{QQ} < 0$.

(2) If $C_X/Q - C_{QX} < 0$, the second term in braces is negative.

As above, the sign of the first term depends upon the sign of $(F_Q + QF_{QQ} - C_{QQ})$.

theorem I-4 (effect upon Revenue)

(1) If $\partial AC/\partial X \geq \partial MC/\partial X$, then an increase in I will result in increased equilibrium level or revenue.

(2) If $\partial AC/\partial X < \partial MC/\partial X$, $\partial Rev^*/\partial I$ cannot be guaranteed positive. However, $\partial Rev^*/\partial I$ can be negative only if $\partial P^*/\partial I < 0$.

proof:

$$(13\text{-}35)\quad \frac{\partial Rev^*}{\partial I} = P^* \frac{\partial Q^*}{\partial I} + Q^* \frac{\partial P^*}{\partial I}$$

but

$$\frac{\partial P^*}{\partial I} = F_I + F_Q \frac{\partial Q^*}{\partial I} + F_X \frac{\partial X^*}{\partial I}$$

$\therefore$

$$(13\text{-}36)\quad \frac{\partial Rev^*}{\partial I} = (F + QF_Q)\frac{\partial Q^*}{\partial I} + Q^*\left(F_I + F_X \frac{\partial X^*}{\partial I}\right)$$

(1) By F.O.N.C. (13-1) and theorem I-1, the first term is nonnegative. F_I and F_X are

positive, therefore, a sufficient condition for

$\frac{\partial Rev^*}{\partial I} > 0$ is that: $\partial X^*/\partial I \geq 0$. By theorem I-2,

this is nonnegative for $\partial AC/\partial X \geq \partial MC/\partial X$.

(2) Since $\partial Q^*/\partial I > 0$, eqn (13-35) implies that $\partial Rev^*/\partial I$ can be negative only if $\partial P^*/\partial I < 0$.

theorem I-5 (effect upon profit)

An increase in I must result in an increase in the physician's profit.

proof:

The proof is identical to the proof of theorem H-5.

J. Effects of an Increase in Y

theorem J-1 (effect upon Q^*)

(1) If $\partial AC/\partial X \geq \partial MC/\partial X$, then an increase in Y will result in an increased equilibrium level of output.

(2) If $\partial AC/\partial X < \partial MC/\partial X$, then it cannot be guaranteed that $\partial Q^*/\partial Y > 0$. The likelihood of a perverse effect ($\partial Q^*/\partial Y < 0$) is greater, the greater the difference between $\partial AC/\partial X$ and $\partial MC/\partial X$.

proof:

$$F_Y = \frac{h'}{1+h} F \quad (13\text{-}37a)$$

and

$$F_{QY} = \frac{h'}{1+h} F_Q \quad (13\text{-}37b)$$

Therefore:

$$(13\text{-}37c)\quad F_Y + QF_{QY} = \frac{h'}{1+h}(F + QF_Q)$$

and

$$(13\text{-}37d)\quad F_{XY} = \frac{h'}{1+h}F_X$$

Substituting eqns (13-37) and $F_{QX} = 0$ into eqn (13-11):

$$\frac{\partial Q^*}{\partial Y} = \frac{1}{\Delta}\left(\frac{h'}{1+h}\right)\left\{-(F + QF_Q)(QF_{XX} - C_{XX}) + QF_X(F_X - C_{QX})\right\}$$

substituting F.O.N.C. (13-2):

$$(13\text{-}38)\quad \frac{\partial Q^*}{\partial Y} = \frac{1}{\Delta}\left(\frac{h'}{1+h}\right)\left\{-(F + QF_Q)(QF_{XX} - C_{XX}) + C_X\left(\frac{C_X}{Q} - C_{QX}\right)\right\}$$

By F.O.N.C. (13-1) and S.O.N.C. (13-5), the first term in braces must be nonnegative.

(1) If $C_X/Q - C_{QX} > 0$, then the 2nd term in braces is also positive, thus $\partial Q^*/\partial Y > 0$.

(2) If $C_X/Q - C_{QX} < 0$, the 2nd term in the braces is negative.

Q.E.D.

theorem J-2 (effect upon X^*)

(1) If $\partial AC/\partial X \geq \partial MC/\partial X$, then the equilibrium level of X will increase with increased Y.

(2) If $\partial AC/\partial X < \partial MC/\partial X$, then the sign of $\partial X^*/\partial Y$ is ambiguous. However, if the equilibrium level of output decreases with increased Y, (i.e., if $\partial Q^*/\partial Y < 0$), then the equilibrium level of X must increase.

proof:

Substituting eqns (13-37) and $F_{QX} = 0$ into eqn (13-12):

(13-39) $$\frac{\partial X^*}{\partial Y} = \frac{1}{\Delta}\left(\frac{h'}{1+h}\right)\left\{(F + QF_Q)\left(\frac{C_X}{Q} - C_{QX}\right) - C_X(2F_Q + QF_{QQ} - C_{QQ})\right\}$$

(1) By S.O.N.C. (13-4), the second term in braces is positive. By F.O.N.C. (13-1), $F + QF_Q$ must be nonnegative. Therefore, the first term in braces is positive if $C_X/Q - C_{QX} > 0$.

(2) Let:

(13-40)

$$a \equiv 2F_Q + QF_{QQ} - C_{QQ} < 0$$

$$b \equiv F_X + QF_{QX} - C_{QX} = \frac{C_X}{Q} - C_{QX} < 0$$

$$e \equiv QF_{XX} - C_{XX} < 0$$

$$S \equiv F_Y + QF_{QY} > 0$$

$$Z \equiv QF_{XY} > 0$$

Using the above notation, equations (13-11) and (13-12) imply the following:

$$\frac{\partial Q^*}{\partial Y} = \frac{1}{\Delta}[-Se + Zb]$$

and

$$\frac{\partial X^*}{\partial Y} = \frac{1}{\Delta}[Sb - Za]$$

We shall show that given $b < 0$, if $-Se + Zb < 0$, then S.O.N.C. require that $Sb - Za > 0$:

$a < 0$, $b < 0$, and $-Se + Zb < 0$ imply:

$$-\frac{a}{b}Se + Za < 0$$

(13-41a) $$\frac{a}{b}Se - Za > 0$$

But S.O.N.C. require that:

$$ae - b^2 > 0 \qquad \text{or:}$$

$$\frac{a}{b}e < b$$

which implies that:

$$\frac{a}{b}eS < Sb \tag{13-41b}$$

Inequalities (13-41a) and (13-41b) together imply that:

$$Sb - Za > 0$$

Q.E.D.

theorem J-3 (effect upon P^*)

The possible signs of $\partial P^*/\partial Y$ are summarized as follows:

	$\partial AC/\partial X > \partial MC/\partial X$	$\partial AC/\partial X = \partial MC/\partial X$	$\partial AC/\partial X < \partial MC/\partial X$
D less convex than exp	?	+	?
D more convex than exp	?	?	?

(1) If $\partial AC/\partial X \approx \partial MC/\partial X$, and if the demand function is less convex than the exponential, then $\partial P^*/\partial Y > 0$.

(2) If $\partial AC/\partial X \geq \partial MC/\partial X$, and the demand function is concave, then $\partial P^*/\partial Y > 0$

(3) If equilibrium output decreases with Y then equilibrium price must increase.

By equations (13-16), (13-37a), (13-38), and (13-39):

$$\frac{\partial P^*}{\partial Y} = \frac{1}{\Delta}\left(\frac{h'}{1 + h}\right)A \tag{13-42}$$

where:

$$A \equiv (QF_{XX} - C_{XX})[F(F_Q + QF_{QQ} - C_{QQ}) - Q(F_Q)^2] + \left(\frac{C_X}{Q} - C_{QX}\right)\left(FC_{QX} + 2QF_Q\frac{C_X}{Q}\right) - \left(\frac{C_X}{Q}\right)^2 Q(2F_Q + QF_{QQ} - C_{QQ}) \tag{13-43}$$

Equation (13-43) may be rewritten as follows:

$$(13\text{-}44)\quad A = (QF_{XX} - C_{XX})[F(F_Q + QF_{QQ} - C_{QQ}) - Q(F_Q)^2] +$$

$$\left(\frac{C_X}{Q} - C_{QX}\right)FC_{QX} - \left(\frac{C_X}{Q}\right)^2 Q(QF_{QQ} - C_{QQ})$$

(1) If $\partial AC/\partial X = \partial MC/\partial X$, the second term in equation (13-43) equals zero. The third term in that equation must be positive by S.O.N.C. (13-5). By assumption b, $C_{QQ} > 0$. Therefore, if the demand function is less convex than the exponential, the first term represents the product of two negative numbers and therefore must be positive. Thus the above conditions are sufficient to insure that A and, therefore, $\partial P^*/\partial Y$ are positive.

(2) If $\partial AC/\partial X > \partial MC/\partial X$, the second term in equation (13-44) is positive. The conditions that $F_{QQ} < 0$ and $C_{QQ} > 0$ are sufficient to insure that the first and third conditions in equation (13-44) are also positive. Therefore, $A > 0$ and $\partial P^*/\partial Y > 0$.

(3) By theorem J-2, $\partial X^*/\partial Y > 0$ if $\partial Q^*/\partial Y < 0$. Since $F_Y > 0$, $F_Q < 0$, and $F_X > 0$, equation (13-16) implies that $\partial P^*/\partial Y > 0$ if $\partial Q^*/\partial Y < 0$.

Q.E.D.

theorem J-4 (effect upon revenue)

(1) If $\partial AC/\partial X \geq \partial MC/\partial X$, then the equilibrium level of revenue must increase with increased Y.

(2) If $\partial Q^*/\partial Y \geq 0$ and $\partial X^*/\partial Y \geq 0$, then $\partial Rev^*/\partial Y > 0$.

proof:

Following the line of reasoning of the proof to theorem I-4:

$$\frac{\partial \mathrm{Rev}^*}{\partial Y} = (F + QF_Q)\frac{\partial Q^*}{\partial Y} + Q^*(F_Y + F_X\frac{\partial X^*}{\partial Y})$$

F.O.N.C. (13-1) requires that marginal revenue $(F + QF_Q)$ be positive. Therefore, if both $\partial Q^*/\partial Y$ and $\partial X^*/\partial Y$ are positive, then $\partial \mathrm{Rev}^*/\partial Y$ must also be positive. By theorems J-1 and J-2, $\partial AC/\partial X \geq \partial MC/\partial X$ insures that $\partial Q^*/\partial Y > 0$ and $\partial X^*/\partial Y > 0$.

Q.E.D.

theorem J-5 (effect upon profit)

An increase in Y must result in an increase in the physician's profit.

proof:

The proof is identical to that of theorem H-5.

K. Effects of an increase in input costs

By definition, an increase in W results in an increase in cost, output and X held constant. That is:

$$C_W(Q, X, W) > 0$$

Furthermore, we shall assume that an increase in W does not result in a decrease in marginal cost. (Thus, W could represent the price of a non-inferior factor of production). And we assume that an increase in W does not result in a decrease in the marginal cost per unit of X. That is, we assume:

(13-45) $C_{QW}(Q, X, W) \geq 0$

(13-46) $C_{XW}(Q, X, W) \geq 0$

theorem K-1 (effect upon output)

The effect of an increase in W upon the equilibrium level of output may be summarized as follows:

$\partial AC/\partial X \geq \partial MC/\partial X$	$\partial AC/\partial X < \partial MC/\partial X$
	?

(1) The perverse effect ($\partial Q/\partial W > 0$) may occur when the difference between $\partial MC/\partial X$ and $\partial AC/\partial X$ is large and/or C_{XW} is large relative to C_{QW}. For example, if $C_{QW} = 0$ (and $C_{XW} > 0$), then $\partial Q/\partial W > 0$ for $\partial AC/\partial X < \partial MC/\partial X$.

proof:

Equations (13-13) and (13-2) imply that

$$\frac{\partial Q^*}{\partial W} = \frac{1}{\Delta}\left\{C_{QW}(QF_{XX} - C_{XX}) - C_{XW}\left(\frac{C_X}{Q} - C_{QX}\right)\right\} \tag{13-47}$$

By S.O.N.C. (13-5), and by assumption (13-45), the first term in braces is negative. Assumption (13-46) implies that the second term in braces is negative when $\frac{C_X}{Q} > C_{QX}$.

(1) If $C_{QW} = 0$, then:

$$\operatorname{sgn}\left[\frac{\partial Q^*}{\partial W}\right] = -\operatorname{sgn}\left[(C_{XW})\left(\frac{C_X}{Q} - C_{QX}\right)\right]$$

Thus in this case, $\partial Q^*/\partial W > 0$ if $\frac{C_X}{Q} - C_{QX} < 0$.

lemma K-1 (effect upon efficient - X locus)

If an increase in W increases the marginal cost per unit of X, then at each level of output, the efficient level of X decreases.

proof:

By equation (13-7):

(13-48) $$\left.\frac{dX}{dW}\right|_{Q,\ \mathrm{eff}\ X} = -\frac{C_{XW}}{C_{XX} - QF_{XX}}$$

By S.O.N.C. (13-5), this term is negative for $C_{XW} > 0$.

theorem K-2 (effect upon X)

The effect of an increase in W upon the equilibrium level of X may be summarized as follows

$\partial AC/\partial X \geq \partial MC/\partial X$	$\partial AC/\partial X < \partial MC/\partial X$
-	?

(1) In the case that $\partial AC/\partial X < \partial MC/\partial X$, if the equilibrium level of output increases with increased W, then the equilibrium level of X must decrease.

proof:

By equations (13-14), (13-2), and $F_{QX} = 0$:

(13-49) $$\frac{\partial X^*}{\partial W} = \frac{1}{\Delta}\left\{- C_{QW}\left(\frac{C_X}{Q} - C_{QX}\right) + C_{XW}(2F_Q + QF_{QQ} - C_{QQ})\right\}$$

By S.O.N.C. (13-4) and the assumption that $C_{XW} \geq 0$, the second term in braces is nonpositive. Thus, $\frac{C_X}{Q} > C_{QX}$ is a sufficient condition for $\partial X^*/\partial W < 0$.

(1) Let:

$s \equiv C_{QW} \qquad \geq 0$

$t \equiv C_{XW} \qquad \geq 0$

$a \equiv 2F_Q + QF_{QQ} - C_{QQ} < 0$

$b \equiv F_X + QF_{QX} - C_{QX} = \frac{C_X}{Q} - C_{QX} < 0$

$e \equiv QF_{XX} - C_{XX} \qquad < 0$

Then eqns (13-13) and (13-14) may be rewritten as follows:

$$\frac{\partial Q^*}{\partial W} = \frac{1}{\Delta}[se - tb]$$

$$\frac{\partial X^*}{\partial W} = \frac{1}{\Delta}[-sb + ta]$$

We will show that for $b < 0$, if $se - tb > 0$, then S.O.N.C. (13-3) requires that $-sb + ta < 0$.

Assume $se - tb > 0$. Since $b < 0$ and $e < 0$, this implies that $sb - tb^2/e > 0$,

(13-50) $-sb + tb^2/e < 0$

But, S.O.N.C. (13-3) requires $b^2 < ae$, which (for $C_{XW} \geq 0$) implies that:

(13-51) $\frac{tb^2}{e} > ta$

Inequalities (13-50) and (13-51) imply:

$-sb + ta \leq -sb + tb^2/e < 0$

Therefore, $\partial X^*/\partial W < 0$ when $\partial Q^*/\partial W > 0$.

Q.E.D.

theorem K-3 (effect upon P^*)

In general the sign of the derivative $\partial P^*/\partial W$ cannot be determined without further specification of the nature of the change in costs. However, in the case that $\partial Q^*/\partial W > 0$, it must be true that $\partial P^*/\partial W < 0$.

proof:

By eqns (13-17), (13-47), and (13-49):

(13-52)
$$\partial P^*/\partial W = \frac{1}{\Delta}\Big\{F_Q[C_{QW}(QF_{XX} - C_{XX}) - C_{XW}(\frac{C_X}{Q} - C_{QX})] + F_X[-C_{QW}(\frac{C_X}{Q} - C_{QX}) + C_{XW}(2F_Q + QF_{QQ} - C_{QQ})]\Big\}$$

Note that by equation (13-17), since $F_Q < 0$ and $F_X > 0$, then $\partial Q^*/\partial W > 0$ and $\partial P^*/\partial W < 0$ is sufficient for $\partial P^*/\partial W < 0$. By theorem K-2, $\partial P^*/\partial W < 0$ if $\partial Q^*/\partial W > 0$. Therefore, $\partial P^*/\partial W < 0$ for $\partial Q^*/\partial W > 0$.

theorem K-4 (effect upon revenue)

The effect of an increase in W upon revenue may be summarized as follows:

$\partial AC/\partial X \geq \partial MC/\partial X$	$\partial AC/\partial X < \partial MC/\partial X$
+	?

proof:

$$\frac{\partial(PQ)}{\partial W} = P^*\frac{\partial Q^*}{\partial W} + Q^*\frac{\partial P^*}{\partial W}$$

Substituting eqn (13-17):

$$\frac{\partial PQ}{\partial W} = (P^* + Q^*F_Q)\frac{\partial Q^*}{\partial W} + Q^*F_X\frac{\partial X^*}{\partial W}$$

F.O.N.C. (13-1) requires that $P^* + Q^*F_Q > 0$. Therefore, the condition that $\partial Q^*/\partial W < 0$ and $\partial X^*/\partial W < 0$ is sufficient for $\partial(PQ)/\partial W < 0$. But by theorems K-1 and K-2, $\partial Q^*/\partial W < 0$ and $\partial X^*/\partial W < 0$ when $\partial AC/\partial X \geq \partial MC/\partial X$.

theorem K-5 (effect upon profit)

The equilibrium level of profit must decrease with an increase in W.

proof:

This theorem may be proved by contradiction. Let Q°, X°, P° represent the original equilibrium values of Q, X and with W equal to W° and let Q', X', P' represent the profit maximizing values with $W = W'$. Let $\pi(Q, X, P, W)$ represent the profit earned by selling Q units of service at price P with X and cost parameter W. Then: for $W' > W^\circ$

$$\pi(Q', X', P', W') < \pi(Q', X', P', W^\circ)$$

Therefore, if $\pi(Q^\circ, X^\circ, P^\circ, W^\circ) < \pi(Q', X', P', W')$ then: $\pi(Q^\circ, X^\circ, P^\circ, W^\circ) < \pi(Q', X', P', W^\circ)$. That is Q°, X°, P° could not have been a profit maximizing choice with input cost parameter equal to W°.

Chapter 14

Effects of Insurance on Physicians' Fees:
Theoretical Considerations

Frank A. Sloan

The first section presents comparative statics analysis of the effects of third party reimbursement on physicians' fees. The second section reviews some empirical aspects of our work on third party reimbursement.

COMPARATIVE STATICS

Assume demand functions and cost functions for a "representative" physician with price-setting power are:

$p = p(y;\ s,\ M)$ and

$C = C(y;\ N)$

and $\pi = p(y;\ s,\ M)y - C(y;\ N),$ (14-1)

where

π = profits;

p = price;

y = output;

s = insurer fee schedule;

M = exogenous factor shifting the demand curve;

N = exogenous factor shifting the cost curve.

$p_y < 0$, $p_s > 0$; $C_y > 0$; $p_M > 0$ and $C_N > 0$ (for illustrative purposes).

The first order condition is

$$\pi_y = p_y y + p - C_y = 0. \qquad (14\text{-}2)$$

A necessary condition for a maximum is that

$$\pi_{yy} = p_{yy} y + 2p_y - C_{yy} < 0 \qquad (14\text{-}3)$$

To gauge the effect of a change in the insurer's fee schedule on physicians' fees, the derivative π_{ys} is required.

$\pi_{ys} = p_{ys} y + p_{ys} > 0$. Then

$$\frac{dy}{ds} = -\frac{\pi_{ys}}{\pi_{yy}} > 0. \qquad (14\text{-}4)$$

$$\frac{dp}{ds} = \overset{-}{\frac{\partial p}{\partial y}}\overset{+}{\frac{dy}{ds}} + \overset{+}{\frac{dp}{ds}} \gtrless 0 \qquad (14\text{-}5)$$

Although output (y) rises with increases in s, the effect of an increased fee schedule on the doctor's fee cannot be determined in advance.

In an alternative (less general) specification, insurance shifts the demand curve vertically. The demand curve shifts upward by an amount given by the product of the proportion of families in the market area with insurance (k) and the fee schedule (s). The shift is illustrated in Fig. 14-1.

Now,

$$\pi = [p(y;M) + ks]y - C(y;N) \qquad (14\text{-}6)$$

The first order condition is

$$\pi_y = p_y y + p_y + ks - C_y = 0 \qquad (14\text{-}7)$$

To ascertain the effect of s on the fee, now called $\tilde{p}(= p(y;M) + ks)$, we need to evaluate the cross-partial π_{ys}.

$\pi_{ys} = k > 0$. Then,

$$\frac{dy}{ds} = -\frac{k}{\pi_{yy}} > 0 \qquad (14\text{-}8)$$

$$\frac{d\tilde{p}}{ds} = \overset{-}{\frac{\partial p}{\partial y}}\overset{+}{\frac{dy}{ds}} + k \gtrless 0 \qquad (14\text{-}9)$$

Again, the effect of s on the fee is indeterminate even though $\frac{dy}{ds}$ is positive. The parameter k enters in exactly the same way as s. So the comparative statics predictions are identical for k and s.

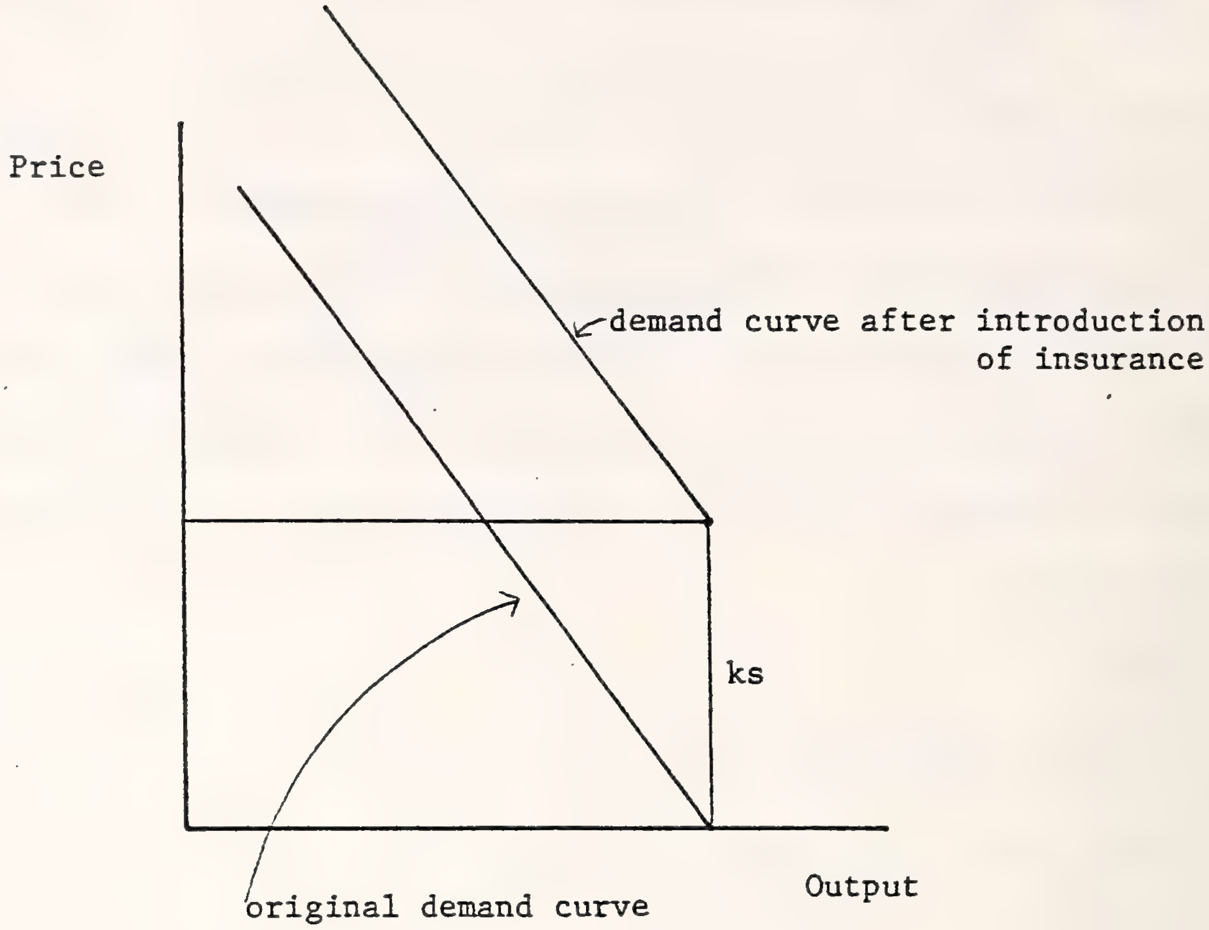


Figure 14-1: Insurance Effect on Physician's Demand Curve

Under UCR, the insurer's fee schedule is endogenous to the individual physician. We shall consider a two period case. The results are generalizable to n periods.

Assume that the physician enters practice in year t and sets a fee p_0. Although he receives no reimbursement immediately, this becomes his fee schedule in year t + 1. Assume zero practice costs since costs *per se* do not have a bearing on the following argument.

The physician faces the following demand curves for t and t + 1:

$$\begin{aligned} p_0 &= f(y_0) \quad \text{and} \\ \tilde{p}_1 &= f(y_1) + kp_0 \end{aligned} \tag{14-10}$$

Then he maximizes the present value (V) of earnings from practice for the two years.

$$V = f(y_0)y_0 + \frac{[f(y_1) + kp_0]y_1}{1 + r} \tag{14-11}$$

where r is the discount rate.

$$V_{y_0} = \frac{\partial f}{\partial y_0} y_0 + f(y_0) + k\frac{\partial f}{\partial y_0} y_1 \left(\frac{1}{1 + r}\right) = 0 \tag{14-12}$$

$$V_{y_1} = \frac{\partial f}{\partial y_1} y_1 + f(y_1) + kp_0 = 0 \tag{14-13}$$

Note from (14-12) that since $k\frac{\partial f}{\partial y_0} y_1 \left(\frac{1}{1 + r}\right)$ is negative, less output is produced in the first period than would be the case if p_0 had no effect on the amount of third party reimbursement received in the next period. $\frac{\partial f}{\partial y_0} y_0 + f(y_0)$ must be positive rather than zero.

Now the two parameters of interest are k and r.

$$V_{y_0 k} = f_{y_0 y_1}\left(\frac{1}{1 + r}\right) < 0 \qquad V_{y_1 k} = p_0 > 0 \qquad V_{y_0 y_1} = kf_{y_0}\left(\frac{1}{1 + r}\right) < 0$$

Then

$$\frac{dy_0}{dk} = -\frac{\begin{vmatrix} V_{y_0 k} & V_{y_0 y_1} \\ V_{y_1 k} & V_{y_1 y_1} \end{vmatrix}}{\underbrace{\begin{vmatrix} V_{y_0 y_0} & V_{y_0 y_1} \\ V_{y_1 y_0} & V_{y_1 y_1} \end{vmatrix}}_{\Delta_1}} = -\frac{\overset{-}{V_{y_0 k}}\overset{-}{V_{y_1 y_1}} - \overset{-}{V_{y_0 y_1}}\overset{+}{V_{y_1 k}}}{\underset{+}{\Delta_1}} < 0 \qquad (14\text{-}14)$$

and

$$\frac{dy_1}{dk} = -\frac{\begin{vmatrix} V_{y_0 y_0} & V_{y_0 k} \\ V_{y_1 y_0} & V_{y_1 k} \end{vmatrix}}{\Delta_1} = -\frac{\overset{-}{V_{y_0 y_0}}\overset{+}{V_{y_1 k}} - \overset{-}{V_{y_1 y_0}}\overset{-}{V_{y_0 k}}}{\underset{+}{\Delta_1}} > 0 \qquad (14\text{-}15)$$

Output falls in the first year and rises in the second year as the proportion of patients with UCR insurance rises.

$$\frac{dp_0}{dk} = \overset{-}{\frac{\partial f}{\partial y_0}}\overset{-}{\frac{dy_0}{dk}} > 0$$

$$(14\text{-}16)$$

$$\text{and } \frac{d\tilde{p}_1}{dk} = \overset{-}{\frac{\partial f}{\partial y_1}}\overset{+}{\frac{\partial y_1}{\partial k}} + \overset{+}{p_0} \gtreqless 0$$

According to (14-16), an increase in k unambiguously raises p_0. The effect on next year's price is ambiguous, given, as before, countervailing forces involving movements along and shifts in the demand curve.

The effects of an increase in r may be evaluated as follows.

$$V_{y_0 r} = -\frac{1}{(1 + r)^2} k \frac{\partial f}{\partial y_0} y_1 > 0.$$

$$V_{y_1 r} = 0.$$

Hence,

$$\frac{dy_0}{dr} = -\frac{\begin{vmatrix} V_{y_0 r} & V_{y_0 y_1} \\ 0 & V_{y_1 y_1} \end{vmatrix}}{\Delta_1} = -\frac{\overset{+}{V_{y_0 r}} \overset{-}{V_{y_1 y_1}}}{\underset{+}{\Delta}} > 0 \qquad (14\text{-}17)$$

and

$$\frac{dy_1}{dr} = -\frac{\begin{vmatrix} V_{y_0 y_0} & V_{y_0 r} \\ V_{y_1 y_0} & 0 \end{vmatrix}}{\Delta_1} = -\frac{-\overset{-}{V_{y_1 y_0}} \overset{+}{V_{y_0 r}}}{\Delta} < 0 \qquad (14\text{-}18)$$

As the physician's discount rate rises, he produces more in the first and less in the second year.

Now,

$$\frac{dp_0}{dr} = \overset{-}{\frac{\partial f}{\partial y_0}} \overset{+}{\frac{dy_0}{dr}} < 0$$

$$(14\text{-}19)$$

$$\text{and} \quad \frac{d\tilde{p}_1}{dr} = \overset{-}{\frac{\partial f}{\partial y_1}} \overset{-}{\frac{dy_1}{dr}} + k \overset{-}{\frac{dp_0}{dr}} \overset{\geq}{<} 0.$$

According to (14-19), price in the first year falls with an increased discount rate; the effect on $\tilde{p}_1$ is uncertain.

This treatment of UCR reimbursement can be extended by assuming, for example, that the probability that the fee schedule will be updated is $0 < \ell < 1$. Assuming the doctor is risk-neutral, the parameter ℓ behaves exactly like the parameter k above. If the doctor is risk averse, the analysis becomes more complicated.

Finally, assume there are two markets, a private market with a fee schedule $\tilde{s}$ and a public market (such as Medicaid) with a fee schedule s. Let x and y be output in the public and private markets, respectively. This model is based on past work on physician participation in Medicaid plans by Sloan, Cromwell, and Mitchell, (1978).

$$\pi = sx + [k\tilde{s} + p(y;M)]y - C(x + y;N),$$

where

$$\tilde{p} = k\tilde{s} + p(y;M)$$

$$\pi_y = k\tilde{s} + p_y y + p(\cdot) - C_y = 0 \tag{14-20}$$

$$\pi_x = s - C_x = 0 \tag{14-21}$$

If the doctor accepts public patients, then both (14-20) and (14-21) apply. Otherwise, if only private patients are accepted, only (14-20) is applicable. Call the latter case, Case 1. The former is Case 2.

Case 1

Under Case 1, an increase in s has no impact on either x or y. To evaluate $\frac{dy}{d\tilde{s}}$, note that $\pi_{y\tilde{s}} = k$. Then,

$$\frac{dy}{d\tilde{s}} = -\frac{k}{\underset{-}{\pi_{yy}}} > 0 \tag{14-22}$$

$$\text{and} \quad \frac{d\tilde{p}}{d\tilde{s}} = k + \overset{-}{\frac{\partial\tilde{p}}{\partial y}}\,\overset{+}{\frac{dy}{d\tilde{s}}} = ? \tag{14-23}$$

According to (14-23), the effect of an increase in $\tilde{s}$ on the private market fee is uncertain.

Case 2

For Case 2, we need $\pi_{xy} = -C_{xy} < 0$, $\pi_{x\tilde{s}} = 0$.

Then,

$$\frac{dy}{d\tilde{s}} = -\frac{\begin{vmatrix} \pi_{xx} & 0 \\ \pi_{yx} & \pi_{y\tilde{s}} \end{vmatrix}}{\underbrace{\begin{vmatrix} \pi_{xx} & \pi_{xy} \\ \pi_{yx} & \pi_{yy} \end{vmatrix}}_{\Delta_2}} = -\frac{\overset{+}{\pi_{y\tilde{s}}}\overset{-}{\pi_{xx}}}{\underset{+}{\Delta_2}} > 0 \tag{14-24}$$

$$\text{and} \quad \frac{dx}{d\tilde{s}} = -\frac{\begin{vmatrix} 0 & \pi_{xy} \\ \pi_{y\tilde{s}} & \pi_{yy} \end{vmatrix}}{\Delta_2} = -\frac{\overset{+}{-\pi_{y\tilde{s}}}\overset{-}{\pi_{xy}}}{\underset{+}{\Delta_2}} < 0. \tag{14-25}$$

When $\tilde{s}$ increases, the doctor allocates output from the public to the private market.

$$\frac{d\tilde{p}}{d\tilde{s}} = k + \frac{\partial p}{\partial y}\frac{dy}{ds} \gtreqless 0 \tag{14-26}$$

To evaluate effects of changes in s on the private market fee, note $\pi_{xs} = 1$ and $\pi_{ys} = 0$. Now,

$$\frac{dy}{ds} = -\frac{\pi_{yx}}{\Delta_2} = -\frac{-\pi_{yx}}{\Delta_2} < 0 \tag{14-27}$$

$$\frac{d\tilde{p}}{ds} = \frac{\partial p}{\partial y}\frac{\partial y}{\partial s} > 0. \tag{14-28}$$

An increase in the public fee schedule ambiguously raises the private market (usual) fee $\tilde{p}$.

The comparative statics results given by equations (14-24) through (14-28) refer to a two market situation in which the physician is a price-taker in the public and a price-setter in the private market. The comparative statics predictions are the same if the physician produces for two private segmented markets.

Let

$$\tilde{p}_1 = k_1 s_1 + p_1(y_1, M_1)$$

$$\tilde{p}_2 = k_2 s_2 + p_2(y_2, M_2)$$

be the demand curves for the two markets. The comparative statics are identical if $\pi_{y_1 s_2}$ and $\pi_{y_2 s_1} = 0$. Then the only connection between the two markets is on the production (cost) side since higher y_1 raises the marginal cost of producing for market 2 and vice versa.

EMPIRICAL IMPLICATIONS

In most cases, the simple models presented above allow one to gauge the effects of changes in coverage proportions (k) and fee schedules (s) on output in qualitative terms. However, the effects of changes in k and s on the physician's usual fee cannot in general be determined on a theoretical basis. The source of the ambiguity is a downward movement along the demand curve accompanying the outward-shift.

Most regressions include a composite insurance variable as an explanatory variable. The composite is the sum of products of k and s for each of the third party payor categories. We have determined that commercial and Blue Shield fee schedules are highly correlated. Hence, we use the Blue Shield fee schedule to represent both.

In a few fee regressions we examine cross fee schedule effects, in particular the impact of the Medicaid fee schedule on the physician's usual fee. The above theory implies that the Medicaid schedule should have no impact on usual fees of physicians who refuse to accept Medicaid patients while the effect of the Medicaid fee schedule on usual fees of participating physicians is unambiguously positive.

Although UCR effects on physicians' fees is discussed in the Final Report in conceptual terms, we were not able to gauge the impact of Blue Shield UCR on physicians' usual fees empirically as we had hoped. The HCFA surveys only obtained data on reimbursements under Blue Shield UCR or its most generous fixed fee schedule plan. We found in our first year that Medicaid reimbursements for specific procedures are no higher when the state program uses UCR, ceteris paribus.

There are two remaining major empirical problems in the insurance area. First, many physicians did not respond to the insurance questions. To deal with this, we have developed equations to allow us to fill in missing values. Second, insurance may be endogenous. For the latter reason, we have experimented with two-stage approaches.

Chapter 15

A Theoretical Model of Medical Malpractice and the Quality of Care

Harris Schlesinger

INTRODUCTION

The effect of insurance purchases on the probability of a loss is known as the problem of moral hazard. The basic contention is that the purchase of insurance coverage lessens an individual's incentives for taking care in loss-prevention. Coinsurance and deductible-type insurance policies lessen the problem somewhat by holding the individual responsible for at least part of the loss. Shavell (1979b) offers a partial solution by basing the insurance premium on the level of care employed by the individual. Sometimes, however, it may be difficult, if not impossible, to determine either *ex ante* or *ex post* how much care was used as is discussed by Shavell.

Consider a firm selling a product for which it may be held liable if the product harms the user. The producer must decide how safe to make his product prior to marketing. The amount of care (i.e. safety level) employed is a part of the product. By increasing the safety level, the product will presumably sell at a higher price. The cost of production will also be higher unless the liability insurance premium reduction for a safer product offsets other production cost increases. In general, the safety level chosen depends upon both consumer demand and the probability of liability litigation. Such is the case with medical care.

This chapter considers the quality of medical care provided when the threat of medical malpractice litigation exists and when malpractice insurance is available as a hedge against this risk. Physician responses to the threat of malpractice litigation may include the purchase of malpractice insurance, changes in the "level of care" rendered, changes in the composition of care (e.g. defensive medicine), changes in the number of patients treated, changes in the types of illnesses treated, and changes in the fees charged for medical services. The scope of this paper is limited to the first two of the above responses and, to a lesser extent, the last as well.

Comparatively little has been written on the effects of uncertainty upon a health care provider's actions. Harris and Raviv (1978), Shavell (1979a), and Reder (1976 a, b) each has a model into which a health care provider (hereafter referred to as the physician) - patient relationship can fit. However, these are alternatives to the present negligence-oriented malpractice system in which legal standards, together with the physician's personal incentives, provide the mechanism of quality-of-care adjustment.

One paper discussing the quality of care in a malpractice context is that of Jerry Green (1978). However, Green's exclusion of insurance as a choice variable of the physician influences many of his results. Also, Green ignores the effect of care on the physician's fee. In addition to lessening the chance of any adverse outcomes for the patient, and thus lowering the probability of any malpractice claims against the physician, the level of care chosen by the physician is part of the product (i.e., service) which the physician markets. This use of care in generating physician income must be considered along with its use as a form of self-protection against losses. Still, the present model extracts much from Green's.

As a means of encouraging physicians to use a socially optimal amount of care, the performance of the malpractice system is unclear.[1] With malpractice insurance as a better hedge against litigation than care, the effects of legal standards on the level of care cannot be guaranteed. The use of care as a form of self-protection against malpractice losses is an alternative to the purchase of malpractice insurance. It is possible for care and insurance to be either substitutes or complements.[2] Consequently, the availability of malpractice insurance affects the performance of litigation as a means of encouraging the use of any targeted level of care.

A main concern in evaluating the quality of care is that there seems to be little agreement as how to define it, how to measure it, and how to improve it. This is further complicated by the lack of sufficient follow-up procedures. In this paper, the concern is not with subjective evaluations of care, but rather with how the physician chooses the level of care he provides and how this choice is affected by the threat of malpractice litigation. Questions concerning the composition of care are not considered, and care is treated as a homogeneous commodity that can be quantified. More care is assumed to be "better" than less in that an infinite amount would be desired if care were costless. (See footnote 8.) Subsequently, the expressions "quality of care" and "level of care" will be used interchangeably.

THE MODEL

Given any patient-physician contract, there is a possibility that the patient will suffer some adverse outcome. This may be some iatrogenic illness or some unforseen complication and might or might not be due, at least in part, to some fault of the physician. The concern here is not with the welfare of the patient, but rather with the actions of the physician. When an adverse outcome occurs the patient may decide to litigate, depending upon whether or not he feels such litigation has a chance of success. This is affected by the patient's perception of the quality of care received, his lawyer's fee schedule for taking the case, and the structure of the tort system.

The physician is assumed to be risk averse. As a hedge against risk, malpractice insurance is available at any liability level the physician chooses. This type of coverage stipulates that the insurance company will pay in full any claim against the physician up to some specified liability limit. For claims exceeding this limit, the insurer is only responsible for an amount equal to the liability limit, the remainder being the responsibility of the physician.[3]

For simplicity, assume that the physician has only one patient-visit per year. Thus, the model ignores any intricacies of repeated trials of random events while leaving intact the basic causes of the uncertainty facing the physician. This admittedly bypasses the problem of multiple claims on a given insurance contract and allows the model to focus on the effects of malpractice on the physician's quality of care decision.

The physician is assumed to add \$I to his income from attending a patient in the absence of any malpractice threat. The amount of care included in a patient visit is that amount which maximizes the physician's income. The physician is assumed to be a price taker. That is to say, his fee schedule relating the level of care to the price charged the patient is determined competitively. If there is a malpractice loss, the physician will add \$I - M to his income where M is random, $0<M<\infty$. In this case, the physician will maximize his expected utility of income as determined by his probabilities of a malpractice loss. Analyzed below are the effects of uncertainty induced by the threat of malpractice litigation on the physician's actions.

Let t denote the probability of the patient's not initiating any litigation against the physician. Although perfect information on the patient's condition might not be available, assume there are sufficient checks in the system so that litigation occurs only if there is an adverse outcome. An adverse outcome might or might not be iatrogenic. Some litigation will be unjustified in the sense that no negligence on the part of the physician has occurred. In other instances, justified litigation might not be pursued because the patient considers the adverse outcome as just "bad luck".

If litigation is pursued, it is up to the court to decide the "truth" given the different information both parties possess. Let q denote the probability that the court finds in favor of the defendant once a suit has been filed. (1 - q) represents the probability that either the court finds in favor of the plaintiff, or an out-of-court settlement is reached. For expositional ease, assume that all cases are settled by the court.[4]

Let h(M) denote the density of M (recall that $M>0$) and define $g(M) = (1 - q)h(M)$. Thus

$$t + (1 - t)q + (1 - t)\int_0^\infty g(M)\,dM = 1.$$

For notational convenience, define

$$p \equiv t + (1 - t)q \equiv \text{the probability of no malpractice loss to the physician.}$$

and

$$f(M) \equiv (1 - t)g(M) = (1 - p)h(M).$$

Hence

$$p + \int_0^\infty f(M)\,dM = 1.$$

Let U(·) denote the physician's (von Neuman-Morgenstern) utility of income.[5] Risk aversion on the part of the physician implies that $U'>0$ and $U''< 0$. The effects of risk aversion on the physician's care and insurance levels are discussed in the following section.

Care will be considered as any steps taken to lessen the probability of the physician's being sued. Ideally, the type of care encouraged by the legal system would also be the most effective way of lessening the probability of any adverse outcome.[6]

Let x denote the level of care employed by the physician and let R(x) denote the physician's fee (or revenue) for administering care level x to a patient. The function R is assumed to be determined within a competitive market. Assume that although the physician's fee is increasing in the level of care, the patient's marginal valuation of extra care is decreasing so that the marginal price charged for additional care is falling. Accordingly, let $R'>0$ and $R''<0$.

Let C(x) denote the cost of administering care level x where $C(x)>0$ for $x>0$ and $C'>0$, $C''>0$.[7,8] Note that as the care level is increased both R(x) and C(x) rise, indicating that it is possible for the physician to pass along an increase in cost to the patient, either in part, in the whole, or, possibly more than the whole. Assume that at some point extra care becomes more expensive than the extra revenue it generates, i.e., let $C'(x)>R'(x)$ for sufficiently large x.

The physician's additional income from attending a patient, in the absence of any malpractice threat, is

$$I(x) \equiv R(x) - C(x). \qquad (15\text{-}1)$$

The physician's objective is then to

$$\text{maximize } U[I(x)] \qquad (15\text{-}2)$$

which requires

$$R'(x) = C'(x).^{9} \qquad (15\text{-}3)$$

The physician's expected utility is defined by

$$EU \equiv pU[R(x) - C(x)] - \int_0^\infty U[R(x) - C(x) - M]f(M)dM. \tag{15-4}$$

Any increase in the care level will, by hypothesis, decrease both the probability of losing a given suit and the probability of litigation occurring. The effects of an increase in the care level on the distribution of losses is not clear. It might cause the density of losses to shift to a stochastically dominating density indicating that any losses that do occur are likely to be lower than if the care level remained unchanged. Or, possibly, a change in the care level only affects the probability of a suit and the probability of a malpractice verdict, leaving the relative distribution of possible losses, h(M), unchanged. Since $g(M) = (1 - q)h(M)$, this would cause g(M) to decrease everywhere as q increased. Assume that, in either case, an increase in the level of care lowers g(M) for all M. Therefore

$$\frac{\partial t}{\partial x} > 0, \frac{\partial q}{\partial x} > 0 \text{ and } \frac{\partial g}{\partial x} < 0 \tag{15-5}$$

which implies that

$$\frac{\partial p}{\partial x} > 0 \text{ and } \frac{\partial f}{\partial x} < 0.^{10} \tag{15-6}$$

Malpractice insurance is assumed available at any liability limit $z \geq 0$. The premium for obtaining liability limit z is πz where $0 < \pi < 1$.[11] The physician must decide upon an optimal mix of care and insurance. Since one option open to the physician is not to attend any patients, he will not spend more on care and insurance than his revenue. Hence, $C(x) + \pi z < R(x)$. Indeed, the possibility of a malpractice loss, $M > 0$, dictates that the inequality above be strict. If the malpractice loss is large enough, the possibility exists that it will bankrupt the physician. However, this problem is beyond the scope of this paper, so it is assumed that bankrupcy does not occur.

The physician's expected utility after care level x and insurance level z have been decided upon is

$$EU \equiv [p + \int_0^z f(M)dM]U(R(x) - C(x) - \pi z) + \int_z^\infty U(R(x) - C(x) - \pi z + z - M)f(M)dM, \tag{15-7}$$

where p and f both depend on the choice of x. The physician is assumed to choose x and z in order to maximize his expected utility.

THE OPTIMAL CARE AND INSURANCE LEVELS

A necessary (first order) condition for the care level to be optimal is

$$[C'(x) - R'(x)]EU' = [\frac{\partial p}{\partial x} + \int_0^z \frac{\partial f}{\partial x}dM]U(R(x) - C(x) - \pi z) + \int_z^\infty U(R(x) - C(x) - \pi z + z - M)\frac{\partial f}{\partial x}dM. \tag{15-8}$$

By increasing his level of care, the physician will have an expected loss in net income of $C'(x) - R'(x)$.[12] However, this extra care lowers his chance of any out-of-pocket losses due to a malpractice claim. The left-hand side (LHS) of equation (15-8) is the expected loss in utility due to the extra cost of a marginal increase in the level of care. The right-hand side (RHS) is the expected gain in utility attributable to the more favorable loss probabilities obtained through a marginal increase in the care level. If, for example, the RHS > LHS, then the expected gain exceeds the expected loss in utility from increasing the care level. In this case $\partial EU/\partial x > 0$ and, *ceteris paribus*, more care should be used. The optimal level of care will equate these expected gains and losses in utility.

Recall that in the absence of a malpractice threat, the optimal care level required $R'(x) = C'(x)$. Let x* denote this level of care. At x* the LHS of (15-8) is zero, but the RHS is positive.[13] Thus, by the argument above, x* is an insufficient level of care. *Consequently, the threat of malpractice litigation increases the level of care used by the physician.*

In addition to increasing his care level, the physician can partially protect himself from malpractice losses through the purchase of insurance. A necessary condition for an expected utility maximizing level of insurance is

$$\pi EU' = \int_z^\infty U'(R(x) - C(x) - \pi z + z - M)f(M)dM. \qquad (15\text{-}9)$$

This has an interpretation similar to that of equation (15-8). The LHS of (15-9) is the extra premium cost in expected utility terms of obtaining a marginal increase in the liability limit. The RHS is the expected gain in utility due to previously uncovered losses that are covered by the increased liability limit.

If there is an upper bound on the range of malpractice awards, so that $\int_L^\infty f(M)dM = 0$ for some L, then it is possible for the physician to purchase full coverage ($z = \inf\{L: \int_L^\infty f(M)dM = 0\}$). Furthermore, the physician has the option of completely self-insuring ($z = 0$). At these two extreme cases, (15-9) need not apply.[14]

Solving for x and z simultaneously

$$\left[\int_z^\infty U'(K + z - M)f(M)dM\right]/\pi = \left[\left(\frac{\partial p}{\partial x} + \int_o^z \frac{\partial f}{\partial x}dM\right)U(K) + \int_z^\infty U(K + z - M)\frac{\partial f}{\partial x}dM\right]/(C'(x) - R'(x)) \qquad (15\text{-}10)$$

where $K \equiv R(x) - C(x) - \pi z$.

The LHS of (15-10) is the expected gain in utility from a higher liability limit (which means an additional out-of-pocket exemption on the part of the physician) divided by the marginal outlay for obtaining this additional coverage. The RHS is the expected gain in utility due to favorable changes in the loss probabilities when the care level is increased, divided by the marginal outlay of the physician for obtaining additional care. Thus, loosely speaking and ignoring uncertainty, a standard microeconomic condition for equilibrium is obtained, equating the ratio of marginal utility to (marginal) price for the two "commodities" being purchased by the physician, namely insurance and care.

THE EFFECTS OF RISK AVERSION ON CARE AND INSURANCE

The optimal level of insurance purchased by the physician is directly related to his degree of risk aversion: the more risk averse the physician, the higher the liability limit on his optimal insurance contract. This is stated in the following proposition.

Proposition 1: An increase in the physician's degree of risk aversion implies, ceteris paribus, that his optimal liability limit will increase.

Proof: (In Appendix H. Also, see Mossin (1968) for a similar result.)

A similar result to Proposition 1 is not obtained for the physician's optimal level of care. A more risk averse physician may decide to use either more care or less care than his less risk averse counterpart, depending upon his loss probabilities. If the chances of a malpractice loss are very slight, an increase in the level of risk aversion will result in more care being used by the physician. However, if malpractice losses seem imminent, an increase in the risk averseness of the physician will cause less care to be used.

Proposition 2: Suppose the physician's degree of risk aversion increases. Then, ceteris paribus,

i) the optimal level of care may either increase or decrease.

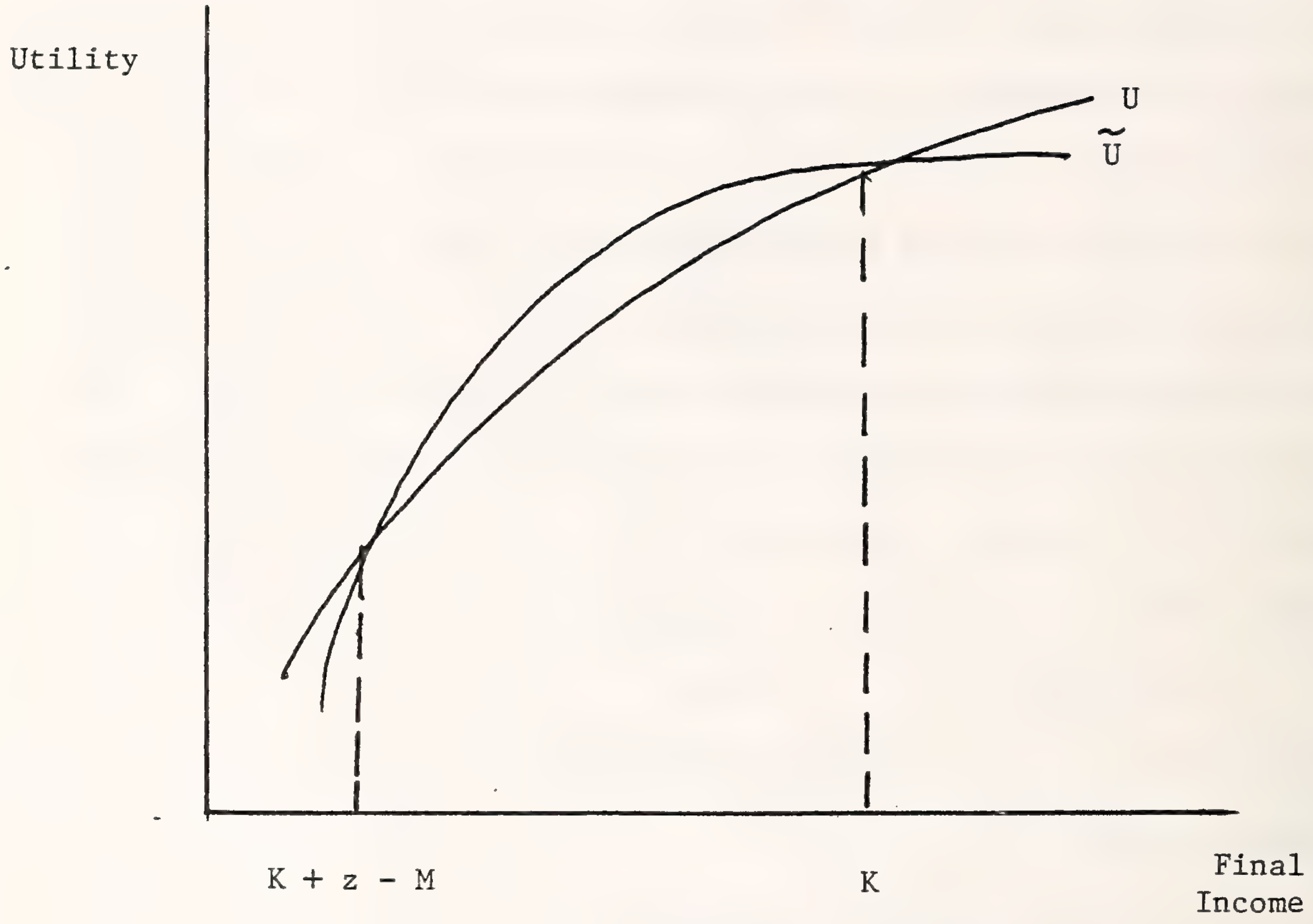
ii) the optimal level of care will increase if p is sufficiently near 1.

iii) the optimal level of care will decrease if p is sufficiently near 0.

Proof: (In Appendix H.)

Interpreting Proposition 2 does not come easily due to the difficulty in conceptualizing "a more risk averse utility function." However, this difficulty can be circumvented by making the simplifying assumption of a two-state model in which

$$\tilde{U}(K) = U(K) \text{ and } \tilde{U}(K + z - M) = U(K + z - M)$$



Risk averseness and the expected cost of care.

Figure 15-1

where $\tilde{U}$ is a more risk averse utility function than U and $K \equiv R(x) - C(x) - \pi z$. (Note that in a two-state model, M is non-random with probability (1 - p) of loss M occurring.) The optimal care level in this case requires

$$[C'(x) - R'(x)][pU'(K) + (1 - p)U'(K + z - M)] = \frac{\partial p}{\partial x}[U(K) - U(K + z - M)] \tag{15-11}$$

Equation (15-11) is the two-state analogue to equation (15-8).

Under the above assumptions

$$\frac{\partial p}{\partial x}[\tilde{U}(K) - \tilde{U}(K + z - M)] = \frac{\partial p}{\partial x}[U(K) - U(K + z - M)],$$

the RHS and LHS each being the expected gain in utility stemming from the more favorable loss probabilities evolving from an increase in the care level. Thus, it is assumed that the physician expects to gain the same additional utility under either utility function, but at different expected utility costs.

$$[C'(x) - R'(x)][p\tilde{U}'(K) + (1 - p)\tilde{U}'(K + z - M)]$$

and the analogous expression for U represent the expected marginal utility costs of this additional care. Note that

$$\tilde{U}'(K) < U'(K) \text{ and}$$
$$\tilde{U}'(K + z - M) > U'(K + z - M).$$

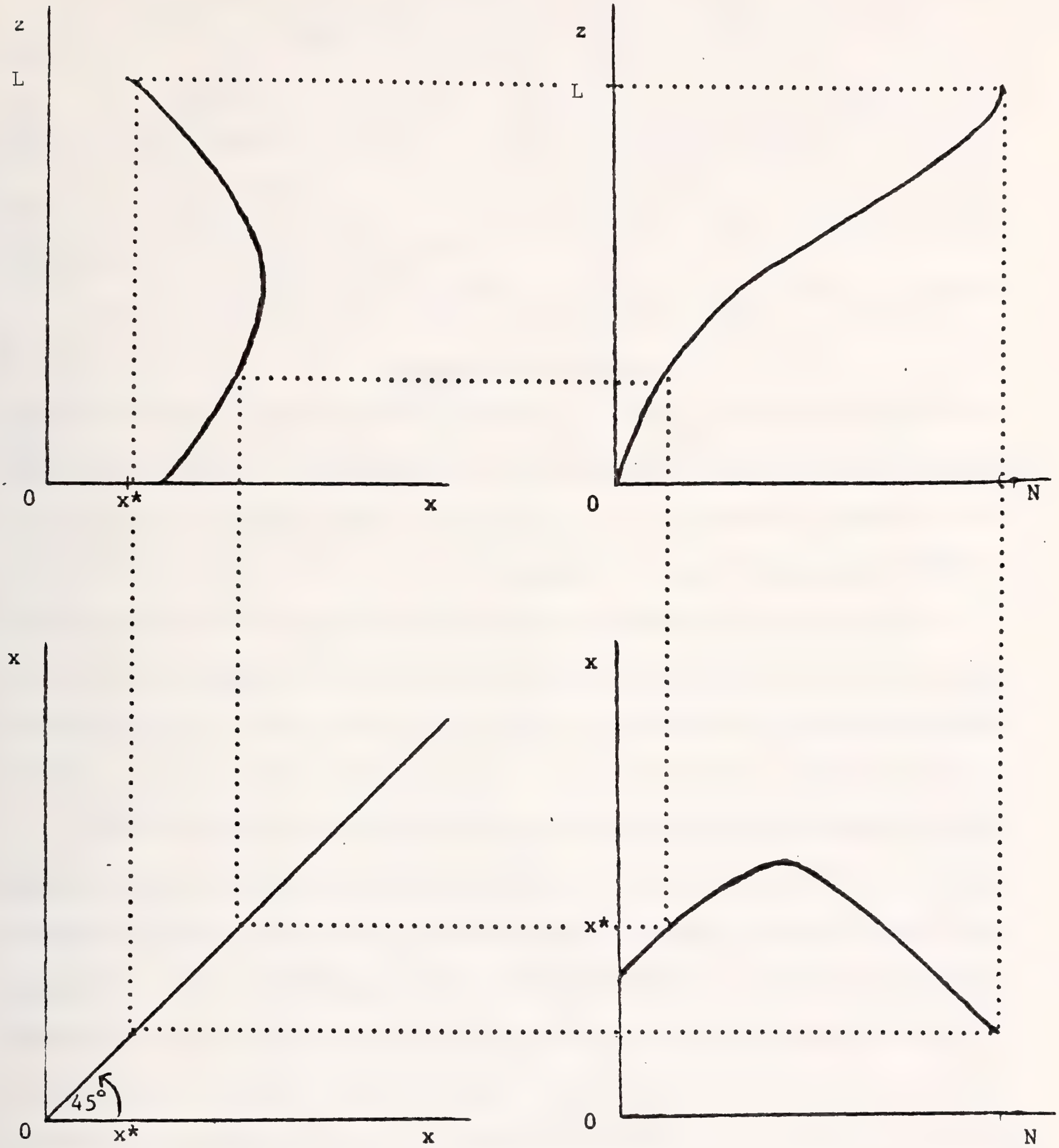
Consequently, the marginal outlay for additional care, $C'(x) - R'(x)$, is worth more in terms of marginal utility for $\tilde{U}$ than for U at $K + z - M$, but more for U than for $\tilde{U}$ at K. In other words, additional care is, ex post, more costly in terms of utility for $\tilde{U}$ if a loss is realized (in which case final income equals K). Consequently, the expected utility cost of care is higher for $\tilde{U}$ if a loss seems imminent (i.e., p is near 0) and, hence, less care will be used under $\tilde{U}$ than under U. Similarly, the expected utility cost of care is lower for $\tilde{U}$ if a loss seems highly improbable (i.e., p near 1) and, hence more care will be used under $\tilde{U}$ than under U.

standard. With the purchase of additional insurance, the physician may decide upon either more care or less care than under the old negligence standard. If the liability limit approaches full coverage, assuming some upper bound on the range of malpractice losses so that full coverage is obtainable, the care level will approach the level that would prevail in the absence of any malpractice threat, namely x*. Since x* has been shown to be an insufficient level of care when litigation is possible, the preceding statement implies that x would need to decrease at some point if it approached x*. This supports our contention that an increase in N may cause x to decrease.

A possible relationship between the negligence standard and the level of care is depicted in Figure 15-2. L denotes an upper limit on the physician's legal liability, and hence z = L represents the purchase of a full-coverage insurance contract. The two uppermost graphs represent possible relationships between the care and insurance levels, and between the insurance level and the negligence standard. Starting with the graph in the northeasternmost quadrant, for a given negligence standard, an optimal liability level is determined. For this liability level, one can determine the optimal amount of care and, consequently, establish the relationship between the negligence standard and the care level.

Even though this relationship is only described as "possible", it must be pointed out that this analysis ignores changes in the price of insurance, π. Any increase in N is likely to result in an increase in π. (See Chapter 5). However, the effects of this increase on x and z are indeterminant.[18]

The total effect of an increase in the negligence standard on the propensity to litigate must take into account the effects of the changing care level. Any increase (decrease) in the use of care will have the effect of decreasing (increasing) the propensity to litigate. An increase in the negligence standard will cause the patient to increase his propensity for



Possible Relationship Between the
Negligence Standard and Care Level

Figure 15-2

initiating a malpractice suit, thus decreasing t. However, this change in N will also affect the care level, x, as will the change in t. If the care level is increased, it will have a lowering effect on the probability of litigation, which will partially or totally offset the increasing effect of the fall in t. If, on the other hand, the care level is decreased, as might be the case when additional insurance is purchased, the total effect of an increase in N will be to increase the probability of litigation.

SUMMARY AND CONCLUSION

This chapter has discussed some of the issues involving medical malpractice insurance and the quality of medical care. The possibility of malpractice litigation causes the physician to use more care, *ceteris paribus*, than if no threat of malpractice litigation existed.

The role of care as both an income generating part of the physician's service and a form of self-protection was considered. The availability of malpractice insurance substantially lessens the role of care as a loss-protection mechanism. At the extreme, if the physician is fully insured, care serves no self-protection purposes, and the level of care rendered by the physician is the same as that which would exist in the absence of any malpractice threat. This has the possible consequence of interfering with the ability of legislative actions to achieve a targeted level of physician care. For example, it has been thought that any modification in tort law which renders litigation easier to pursue forces the physician to use more care. However, a possible physician response is to substitute insurance for care, yielding a lower level of care than before the tort law modification.

The risk averseness of the physician was determined to be a key factor in the choice of the optimal care and insurance levels. The usual result of increased risk aversion implying increased insurance coverage holds in the present model. However, the effects of risk aversion of the level of care provided depend upon the physician's loss probabilities. If the probability of a malpractice loss is very remote, an increase in the physician's degree of risk aversion causes the care level to increase. Just the opposite effect occurs if a malpractice loss seems imminent.

The above analysis has all been in the nature of positive economics. To close with a normative note, both the physician and the patient would gain if the physician's payment could be linked to outcome. There exist risk-sharing fee contracts between the physician and patient, based upon the degree of benefit received by the patient,which are Pareto efficient.[19] However, it is not likely that the outcome of treatment can be measured on a totally objective basis. Incentives exist for the physician to overstate, and the patient to understate, his perception of benefits. Another problem may develop in that iatrogenic illnesses may be discovered at a later date, necessitating a rebate from the physician to the patient.

Although outcome cannot be perfectly discerned, it seems reasonable that in many, if not most, cases, there will be little room for significant disagreement. Indeed, many adverse outcomes are fairly common. Physician-patient contracts for these outcomes could be readily obtainable. Any nonindemnified adverse outcomes, as well as any disputed cases, could then be relegated to the courts.

FOOTNOTES TO CHAPTER 15

[1] A socially optimal care level would be one for which the marginal social benefits of care equal the marginal social costs of care. For possible approaches to a socially optimal care level determination, see Green (1978) and Polinsky (1980)

[2] I use the term "self-protection" in the sense of Ehrlich and Becker (1972) who showed that self-protection and market (malpractice) insurance may be substitutes or complements.

[3] I use the existing form of malpractice coverage which is the liability-limit type. This type of coverage is not, in general, optimal to either the physician or his insurance company. Indeed, a policy with an upper limit of coverage less than full coverage is not Pareto optimal under fairly broad assumptions. However, this type of policy may be the best an insurer can offer under regulatory restraint. (Raviv (1979), pp. 89-91.) Under the set of assumptions employed in the model, the optimal form of insurance policy will entail a deductible. Furthermore, if the physician's choice of a care level affects only the probability of a malpractice loss and not the size of such a loss, given that a loss occurs, then the optimal insurance contract will entail a deductible alone so long as the insurer is risk neutral (Hölmstrom (1979) p. 81).

[4] I assume that the cost to the physician of any trial in which he is found not guilty is zero. It is not difficult to include court costs in the model, but this does not have any major effects on the results and renders the notation more arduous.

[5] The physician's utility may be state dependent in the sense of the physician suffering nonpecuniary disutility from successful malpractice litigation. However, there is no available mechanism, and certainly no jusitifiable reason to compensate physicians for "pain and suffering" or "loss of reputation" resulting from negligence. I use a state independent utility function which has the advantage of capturing the physician's degree of risk aversion in a measurable fashion. [See Pratt (1964)]. For a discussion of state dependent utilities, the reader is referred to Shavell (1978).

[6] The threat of malpractice litigation often encourages physicians to engage in modifications of their usual procedures in order to lower the probability of being found negligent should litigation occur. This practice is commonly known as defensive medicine. Increasing the level of care via defensive medicine might have little effect on the patient's well-being, but will lower the probability of a physician's being found negligent (i.e., increase q) which will, in turn, cause some patients to reconsider litigation (i.e., increase t). Frequent forms of defensive medicine include such procedures as taking x-rays, calling for frequent follow-up examinations, and prescribing additional medications. Records are kept of these activities and are readily available to the court. Although more efficient methods of ensuring a better expected outcome for the patient might exist, these defensive practices are those which are encouraged by the legal system. Certainly any tort law modifications would affect which types of precautionary procedures are undertaken by the physician. See Chapter 5.

[7] This assumption is not necessary, but does not alter any of the results. All that is needed is that beyond some level of care, costs exceed any obtainable revenues.

[8] If care were costless, an infinite amount of care would be desired by the physician. Using notation to be discussed shortly, the physician's objective is to

$$\text{maximize } EU \equiv pU[R(x) - C(x)] + \int_0^\infty U[R(x) - C(x) - M]f(M)dM.$$

Taking p and f as depending on the care level, x, and differentiating with respect to x, if $C(x) \equiv 0$, then

$$\frac{\partial EU}{\partial x} = \frac{\partial p}{\partial x}U[R(x) - C(x)] + \int_0^\infty U[R(x) - C(x) - M]\frac{\partial f}{\partial x}dM +$$

$$R'(x)\{pU'[R(x) - C(x)] + \int_0^\infty U'[R(x) - C(x) - M]f(M)dM\}.$$

The last term in the above expression is positive, since $R' > 0$ and $U' > 0$.

Considering the first two terms

$$\frac{\partial p}{\partial x}U[R(x) - C(x)] + \int_0^\infty U[R(x) - C(x) - M]\frac{\partial f}{\partial x}dM \quad >$$

$$\frac{\partial p}{\partial x}U[R(x) - C(x)] + \int_0^\infty U[R(x) - C(x)]\frac{\partial f}{\partial x}dM \text{ since } \frac{\partial f}{\partial x} < 0 \text{ and } U' > 0.$$

But this last expression equals zero since $\frac{\partial p}{\partial x} = -\int_0^\infty \frac{\partial f}{\partial x}dM$.

Consequently, $\partial EU/\partial x > 0$ and an infinite amount of care is desired.

[9] The physician's initial wealth is being left out for expository ease. To do this, let U(0) denote the physician's degree of risk aversion at his initial wealth level. Also allow $I(x) < 0$ since I(x) represents a net change in total wealth. Finally, let $U(0) > 0$ reflecting a positive utility for the initial wealth level of the physician.

[10] Any changes in g are assumed to be 'smooth' so that $\partial g/\partial x$ is integrable. Certainly, if the density of M remains unchanged,

$$\frac{\partial g}{\partial x} = -\frac{\partial q}{\partial x}h(x)$$

which is intergrable whenever h is.

[11] A premium function which is linear in z is not necessary, though I choose to use one. Any monotonic increasing function $\pi(z)$ is sufficient. A problem of moral hazard on the part of the physician might be handled by including the care level as a determinant of the premium yielding $\pi(z, x)$. I do not concern myself with this problem in this paper. For a discussion of a general insurance model incorporating moral hazard, see Shavell (1979b).

[12] This "loss" will be a gain if $C'(x) - R'(x) < 0$.

[13] Although $\partial f/\partial x < 0$, the RHS of (8) is positive except when full coverage is purchased, in which case it is zero. The proof is similar to the one used in deriving the inequality in footnote 8.

[14] I will not concentrate on corner solutions in the present paper. For a discussion of corner solutions in an insurance context, see Schlesinger (1980) and Mossin (1968). All solutions in the present paper are assumed to be interior solutions.

[15] A similar relationship is discussed by Green (1978). In his paper, Green distinguishes between an _ex ante_ notion of the patient's perceived level of care received and the court's _ex post_ judgment as to the level of care provided. Thus, there is not perfect information as to the level of care provided. The patient, along with his attorney, first decides whether or not to undertake litigation, such litigation being initiated if the _ex ante_ perceived level of care lies below some cutoff level, $\bar{x}$. This being so, it is up to the court to decide, _ex post_ and using all available information, the outcome of the case.

[16] For a more detailed discussion of legislative responses see, for example, Chapter 5, Kendall (1978), or Editors (1977).

[17] Additional care will cause more favorable loss probabilities which will, in turn, cause an increase in expected income. This increase in expected income thus yields a gain in the physician's expected utility.

[18] While an increase in the price of insurance, π, would be expected to decrease z, this effect cannot be guaranteed. If the physician's level of risk aversion is decreasing in wealth, as is likely, then insurance will be an inferior good. [See, for example, Schlesinger (1980).] Consequently, it is possible for an increase in π to cause a increase in z if the income effect is very strong, although this does not seem likely. Comparative statistics on x and z show an ambiguity in sign for both $\partial z/\partial \pi$ and $\partial x/\partial \pi$. (Results are available from the author on request.)

[19] This arrangement was referred to as "ideal insurance" by Arrow (1963). Mathematical formulations have been developed by Harris and Raviv (1978, 1979), Shavell (1979a), and Holmström (1979). A Pareto optimal insurance contract entails the physician's choice function for an insurance contract given a set of alternatives. The insurer must choose the expected profit maximizing set of alternatives given this choice function. See Raviv (1979), pp. 89-91.

APPENDICES

APPENDIX A

HCFA-NORC Income and Expense Data

Bruce Steinwald

INTRODUCTION

Several questions regarding income and related data from the HCFA-NORC surveys have been raised. There are two basic issues: The first is representativeness; that is, are the data from the HCFA-NORC surveys representative of office and hospital based physician practices. Part of this issue pertains to geographic representativeness, which is not addressed in this appendix. The second issue pertains to reliability of the data; that is, are the questions on the HCFA-NORC surveys eliciting net and gross income data that are not systematically biased. This issue is addressed by exploring the content of HCFA-NORC survey questions, by examining some specific features of data on net and gross incomes, and by comparing with income data from American Medical Association and Medical Economics surveys.

NET INCOME DATA--WEIGHTS AND ADMUSTMENTS

Table A-1 provides 1976 data on net incomes by specialty from the HCFA Specialty Group A and B surveys. This table was constructed so as to permit comparisons between weighted and unweighted data and between means and medians. In addition, adjustments to net income figures were performed in order to facilitate comparisons between income data that include estimates of deferred income to corresponding data without such estimates. All three specialties from the Specialty Group B survey are reported, and four (basic) specialties from the Group A survey are reported (General Surgeons, Internists, OBGYN Specialists, and Pediatricians), as well as summary statistics pertaining to all office-based physicians.

The HCFA survey used a stratified random sample design. Three classification variables were employed to divide the total sample into 360 strata. The three classification variables are: specialty, of which there are 18; geographic region, of which there are 4; and county group size, of which there are 5. The sample was stratified such that the number of sample members

Table A-1:Mean and Median Physicians' Net Incomes by Specialty, 1976

	Anesthe-siology	Path-ology	Radi-ology	Internal Medicine[a]	General Surgery[a]	OBGYN[a]	Pedi-atrics[a]	All Office-based MDs[a]
1. Mean Net Income, Unweighted	$60,927	$60,394	$70,338	$58,795	$63,683	$67,771	$49,138	$58,949
2. Mean Net Income, Strata Weights (WT1)	62,831	59,484	70,391	58,007	63,022	65,638	49,911	57,329
3. Mean Net Income, Population Weights (WT2)	62,907	60,583	69,226	58,228	62,738	65,483	49,916	57,489
4. Median Net Income, Strata Weights (WT1)	55,463	55,046	65,024	54,860	64,657	49,994	45,437	54,988
(n)	(150)	(151)	(141)	(261)	(316)	(326)	(304)	(2,867)
5. Adjusted Mean Net Income, Unweighted	70,507	68,544	83,480	62,415	69,935	75,156	52,125	64,114
6. Adjusted Mean Net Income, Strata Weights (WT1)	73,246	67,072	83,617	61,825	69,665	71,823	53,064	61,910
7. Adjusted Mean Net Income, Population Weights (WT2)	72,425	68,441	82,476	62,246	69,109	71,610	53,050	61,870
8. Adjusted Median Net Income, Strata Weights (WT1)	66,158	58,341	77,499	60,006	68,311	71,504	49,998	56,500
(n)	(117)	(133)	(109)	(207)	(240)	(261)	(259)	(2,369)

[a] Fee-for-service, office-based MDs only

Source: HCFA-NORC Survey, 1977.

drawn from each stratum resulted in disproportionate sampling, in accordance with common practices of stratified sampling. The HCFA survey data tapes contain information that allows the researcher to weight observations in the following ways: The first weight factor permits the researcher to weight observations such that the sample is destratified; that is, the weighted observations result in a sample that would resemble a nonstratified sample. A second weight factor combines the above weight with information on cooperation rates of physicians in different strata; that is, application of this weight permits the researcher to construct a sample where each sample member represents a proportionate number of physicians in each stratum. There is a third factor on the survey tapes that does not concern us here.

Table A-1 gives information on mean net incomes by specialty that are unweighted, weighted by the first weighting factor (WT1), and weighted by the second weighting factor (WT2). For research purposes, it is probably better to use the second weighting factor, as this is the closest representation of actual population distributions of physicians. However, for comparison with survey data from other sources, it is probably best to use the second weighting factor, as (to the best of my knowledge) other organizations collecting survey data on physicians do not attempt to adjust data for cooperation rates of physicians of different types.

Table A-1 is divided into two parts: The first part contains information on net incomes, the second on adjusted net incomes. The adjustment, in this instance, is for deferred income that is not reported directly in the net income responses. Estimation of deferred income results in the loss of some cases. which is reflected in the n's between the first and the second sections of the table. For office-based physicians, the adjustment results in an increase in mean net income of approximately $5,000. This amount, of course, varies slightly from specialty to specialty, and the difference is less for median incomes than for means. The adjustment tends to result in a far greater increase in mean net income for hospital-based physicians than for office-based. The difference ranges between approximately $8,000 for pathologists to $13,000 for radiologists. Surveys conducted by the American Medical Association do not add estimates of deferred income into their reported net incomes, but the Medical Ecomomics survey does request respondents to include deferred income in their net income responses. Thus, comparisons with other surveys require both unadjusted and adjusted HCFA net income data.

In Table A-1, rows 4 and 8 report median net and median adjusted net incomes, respectively, to provide an indication of the extent to which means (rows 2 and 6) and medians differ in the income statistics. As one would expect, the medians are somewhat below the comparable means, reflecting some skewedness in the distribution of net incomes among physicians. Regardless of whether adjusted or unadjusted figures are used or whether means or medians are compared, radiologists have the highest net incomes of the specialties reported, followed by OBGYN specialists, anesthesiologists, general surgeons, pathologists, internists, and pediatricians. The office-based physicians represented in Table A-1 are all fee-for-service practitioners, while the hospital-based physicians are compensated under a variety of arrangements.

The effects of stratification may be seen by comparing unweighted mean net income figures to comparable means based on cases that are weighted by strata weights (WT1) or weighted by population weights (WT2). Because sparsely populated areas were oversampled, and the income figures are not deflated by a price index, one expects the unweighted figures to be somewhat less than the weighted figures. This is true in most cases but not in every case. For some specialties, however, the differences between weighted and unweighted means are substantial. In contrast, the differences between the two weighted income series are not substantial. A substantial difference would imply that cooperation rates vary systematically with physician characteristics that are related to earnings. The fact that the differences are not large means that cooperation rates do not vary systematically by stratum and/or that differential cooperation rates are not related in any systematic fashion to physicians' net incomes. This suggests that surveys that do not adjust data for varying cooperation rates in the different physician strata do not lose much in accuracy.

COMPARISONS BETWEEN INCOME AND EXPENSE DATA REPORTED FROM HCFA-NORC, AMA, AND MEDICAL ECONOMICS SURVEYS

It has been suggested that net income data from the HCFA-NORC surveys appear very low compared to comparable incomes reported from other physician surveys. Questions on physicians' incomes and expenses from the HCFA-NORC Survey, American Medical Association Periodic Survey of Physicians, and Medical Economics surveys are exhibited in Table A-2. The AMA questionnaire requests respondents to report their net incomes to the nearest thousand dollars, while both the HCFA and Medical Economics surveys provide income ranges for respondents to check off. Both of the latter questionnaires have an open-ended response choice for writing in actual net income for the highest income physicians.

All three surveys have a single question for net income, regardless of the physician's type of practice (solo vs group, incorporated vs unincorporated, etc.). In the past, the Medical Economics questionnaire used to have separate questions for MDs in different practice arrangements, but in recent years, their questionnaire has been simplified. ME has a single set of net income, gross income, and expense questions which request non-solo MDs to give only their individual shares of the group's income and expenses. Apparently, ME has found it to be unnecessary (or undesirable) to have separate questions for different types of physicians. AMA also has only a single set of questions which require respondents to give only their own shares.

In contrast to the above, the HCFA questionnaire is more complex and combines different response and physician classification techniques. Range responses are included for gross and net incomes but actual deductions are requested. A single net income question is asked of all respondents, but separate gross income and deductions questions are asked of MDs in partnerships or incorporated practices from MDs in other forms of practice. In no case is the respondent requested to give his individual share of the practice's income or deductions. Researchers, therefore, must compute per MD gross income and deductions using data from elsewhere in the survey on number of physicians in the practice. This has the advantage of avoiding having the respondent do the calculating (which may, in some cases, lead to missing values) but there are some disadvantages as well (inability to incorporate unequal sharing, lack of precision on number of FTE MDs in the practice, etc.). It would be instructive to compare response rates and data quality on these questions between the three surveys to assess which is the best method of obtaining per MD income and expense data for non-solo MDs.

Table A-2: Income and Expense Questions from Three Physician Surveys

1. HCFA - NORC

IF EMPLOYEE, UNINCORPORATED SOLO OR UNINCORPORATED GROUP PRACTICE, ASK Q's. 55-57

*55. In which of these broad groups was your own gross income from medical practice in 1976 before practice deductions and taxes? Was it . . .

1. less than $40,000, ... 01 11-12/ [illegible]
2. $40,000 to less than $50,000, ... 02
3. $50,000 to less than $60,000, ... 03
4. $60,000 to less than $70,000, ... 04
5. $70,000 to less than $80,000, ... 05
6. $80,000 to less than $90,000, ... 06
7. $90,000 to less than $100,000, ... 07
8. $100,000 to less than $150,000, ... 08
9. $150,000 to less than $200,000, ... 09
10. $200,000 or over? . . . About how much was that? $________ 10 13-18/ 219

---

*56. How much did you pay for yourself for pensions or retirement plans in 1976?

$________ 19-24/ 220

Nothing 0

---

*57. During 1976, what were your total deductions for your medical practice?

$________ 25-30/ 221

NOW GO TO Q. 62

IF PARTNERSHIP OR INCORPORATED SOLO OR INCORPORATED GROUP, ASK Q's. 58-61

*58. In which of these broad groups was the gross income of the partnership or corporation during 1976 before practice deductions and taxes? Was it . . .

1. $50,000 to less than $75,000, ... 01 31-32/ 222
2. $75,000 to less than $100,000, ... 02
3. $100,000 to less than $125,000, ... 03
4. $125,000 to less than $150,000, ... 04
5. $150,000 to less than $200,000, ... 05
6. $200,000 to less than $250,000, ... 06
7. $250,000 to less than $300,000, ... 07
8. $300,000 to less than $400,000, ... 08
9. $400,000 to less than $500,000, ... 09
10. $500,000 or over? . . . About how much was that? $________ 10 33-39/ [illegible]

*59. How much did the partnership or corporation pay for pensions and/or profit sharing plans during 1976?

$________ 40-46/ 224

Nothing 0

---

*60. IF CORPORATION ONLY, ASK: What did the corporation pay for officers' compensation during 1976?

$________ 47-53/ 225

---

*61. What were your total deductions during 1976 for the partnership or corporation?

$________ 54-60/ 226

ASK EVERYONE

*62. In which of these broad groups was your own net income from the practice of medicine in 1976 after practice deductions and before taxes? Was it . . .

1. less than $20,000, ... 01 61-62/ 227
2. $20,000 to less than $30,000, ... 02
3. $30,000 to less than $40,000, ... 03
4. $40,000 to less than $50,000, ... 04
5. $50,000 to less than $60,000, ... 05
6. $60,000 to less than $70,000, ... 06
7. $70,000 to less than $80,000, ... 07
8. $80,000 to less than $90,000, ... 08
9. $90,000 to less than $100,000, . . . 09
10. $100,000 or over? . . . About how much was that? $________ 10 63-68/ 228

Table A-2, Continued.

2. AMA

C. INCOMES AND EXPENSES

1. What was your GROSS INCOME from MEDICAL PRACTICE in 1975 to the nearest $1,000? (*INCLUDE all income from fees, salaries, retainers, etc. BEFORE expenses and taxes, as well as the value of all fringe benefits paid on your behalf, e.g. Keogh Plan. If in practice with other physicians, give only YOUR share of the practice's gross income.)*

1975 Gross Income = $__________,000 (25-27)   *PROJECTED* 1976 Gross Income = $__________,000 (28-30)

2. What were your total PROFESSIONAL EXPENSES in 1975 to the nearest $1,000? (*INCLUDE only those expenses that are allowable business deductions for Federal income tax purposes. If in practice with other physicians, give only YOUR share of the practice's expenses.)*

1975 Professional Expenses = $__________,000 (31-33)   *PROJECTED* 1976 Professional Expenses = $__________,000 (34-36)

3. What was your 1975 INDVIDUAL NET INCOME BEFORE TAXES from medical practice to the nearest $1,000?

1975 Individual Net Income
Before Taxes = $__________,000 (37-39)

PROJECTED 1976 Individual Net Income
Before Taxes = $__________,000 (40-42)

3. Medical Economics

7. PLEASE SPECIFY YOUR INDIVIDUAL 1977 GROSS PRACTICE INCOME. *(If in practice with other physicians, give only your share of gross income.)* 21- 22- 23- 24-

21-1 ☐ Less than $30,000
-2 ☐ $30,000-39,999
-3 ☐ $40,000-49,999
-4 ☐ $50,000-59,999
-5 ☐ $60,000-69,999
-6 ☐ $70,000-79,999
-7 ☐ $80,000-89,999
-8 ☐ $90,000-99,999
-9 ☐ $100,000-109,999
-0 ☐ $110,000-119,999
24-1 ☐ $120,000-129,999
-2 ☐ $130,000-139,999
-3 ☐ $140,000-149,999
-4 ☐ $150,000-159,999
-5 ☐ $160,000-169,999

If $170,000 or more, *please specify amount:* -6 ☐ $________________

8. PLEASE SPECIFY YOUR INDIVIDUAL 1977 TAX-DEDUCTIBLE PROFESSIONAL EXPENSES. *(If in practice with other physicians, give only your share of total expenses. If in a professional corporation, exclude shareholders' salaries and bonuses and retirement contributions credited to shareholders.)* 27- 28- 29- 30-

31-1 ☐ Less than $7,500
-2 ☐ $7,500-9,999
-3 ☐ $10,000-14,999
-4 ☐ $15,000-19,999
-5 ☐ $20,000-24,999
-6 ☐ $25,000-29,999
-7 ☐ $30,000-39,999
-8 ☐ $40,000-49,999
-9 ☐ $50,000-59,999
-0 ☐ $60,000-69,999
32-1 ☐ $70,000-79,999
-2 ☐ $80,000-89,999
-3 ☐ $90,000-99,999

If $100,000 or more, *please specify amount:* -4 ☐ $________________

9. IF IN UNINCORPORATED PRACTICE, PLEASE SPECIFY YOUR INDIVIDUAL 1977 NET INCOME FROM PRACTICE *(earnings after tax-deductible professional expenses but before income taxes).*

OR

IF IN A PROFESSIONAL CORPORATION, PLEASE SPECIFY YOUR INDIVIDUAL 1977 TOTAL COMPENSATION *(sum of salary, bonuses, and contributions to pension and/or profit-sharing plans made in your behalf)* 33- 34- 35- 36-

37-1 ☐ Less than $20,000
-2 ☐ $20,000-24,999
-3 ☐ $25,000 29,999
-4 ☐ $30,000-34,999
-5 ☐ $35,000-39,999
-6 ☐ $40,000-44,999
-7 ☐ $45,000-49,999
-8 ☐ $50,000-59,999
-9 ☐ $60,000-69,999
-0 ☐ $70,000-79,999
38-1 ☐ $80,000-89,999
-2 ☐ $90,000-99,999
-3 ☐ $100,000-109,999
-4 ☐ $110,000-124,999
-5 ☐ $125,000-134,999
-6 ☐ $135,000-149,999

If $150,000 or more, *please specify amount:* -7 ☐ $________________

Finally, there are differences among the three questionnaires in how they refer to the deductions from gross income that are necessary to arrive at a net income figure after practice deductions and before taxes. The AMA survey simply requests individual net income before taxes, without any reference to expenses or deductions. The Medical Economics survey requests respondents to indicate net income from practice after subtracting tax deductible professional expenses. The AMA and ME questionnaires refer to "expenses," while the HCFA questionnaire refers to "deductions" Ex ante, it is not apparent that this difference in terminology should lead to different response magnitudes, but some differences are present in the data, as discussed below.

Both the AMA and Medical Economics surveys use probability samples of physicians. The AMA surveys all patient care MDs while Medical Economics surveys only office-based specialties. HCFA surveys both office-based and hospital-based MDs, but only selected specialties. Therefore, summary statistics which combine specialties are not comparable across the three surveys.

In addition to the above difference, members of the HCFA sample worked at least 20 hours in a reference week in 1977, were practicing in the same specialty in 1977 as 1976, and were not members of groups of 10 or more MDs. The AMA and Medical Economics samples are not limited by these criteria, and it is uncertain to what degree these differences affect income and expense comparisons. AMA data on incomes by specialty and group size suggest that exclusion of large-group MDs from the HCFA sample should not affect comparisons greatly; incomes of these MDs tend to be near the mean within specialties. However, exclusion of MDs with short work weeks may tend to inflate HCFA incomes and expenses relative to the other surveys. It is possible, perhaps likely, that AMA and Medical Economics data are screened to exclude MDs with extremely short working times, but published data do not identify any such screens. In any case, these differences should be kept in mind when comparing income and expense figures.

Table A-3 provides statistics on net incomes, gross incomes, and expenses by specialty from each of the three surveys for 1976. Differences between comparable statistics computed from the three surveys are apparent in the table. Comparisons are limited by the manner in which the statistics are reported by AMA and Medical Economics. For example, Medical Economics reports only medians, without indicating the number of respondents in each specialty. AMA reports means and medians for net income, but only means are reported for professional expenses, and gross incomes are not reported at all. Thus,we have included statistics from the HCFA data that have comparable analogs in at least one of the other surveys.

The specialties shown in Table A-3 are those that permit the greatest number of comparisons. Because the ME survey does not include hospital-based MDs, comparison of HBPs are limited to the specialties reported by the AMA -- anesthesiology and radiology. The AMA and HCFA survey combine general and family practice while the Medical Economics survey reports these specialties separately. Therefore, no generalists are represented in Table A-3. (Incidentally, the ME survey indicates some substantial differences between general and family practice, which leads one to question the wisdom of combining these specialties in the HCFA survey.) Because aggregated data from the three surveys are not comparable, no total columns are presented in Table A-3.

Numbers of respondents are not shown in Table A-3, but they are of the same approximate order of magnitude. The HCFA-NORC and AMA surveys had 2,867 and 3,857 respondents, respectively, to their 1977 surveys. Medical Economics does not

Table A-3: Comparisons of Physicians' 1976 Net Incomes, Gross Incomes, and Professional Expenses from Three Surveys: Health Care Financing Administration (HCFA), American Medical Association (AMA), and Medical Economics, Incorporated (ME)

	Anesthe-siology	Radi-ology	Internal Medicine	General Surgery	OBGYN	Pedi-atrics
1. HCFA: Mean Net Income	$ 62,831	$ 70,391	$ 58,007	$ 63,022	$ 65,638	$ 49,911
2. AMA: Mean Net Income	60,059	77,322	60,459	73,245	65,800	46,962
3. HCFA: Median Net Income	55,463	65,024	54,860	64,657	64,830	45,437
4. AMA: Median Net Income	59,600	74,909	55,190	65,412	62,000	44,955
5. HCFA: Adjusted Median Net Income	66,158	77,499	60,006	68,311	71,504	49,998
6. ME: Median Net Income	--	--	60,000	69,910	76,120	51,300
7. HCFA: Median Gross Income	87,393	116,618	94,968	112,501	116,584	84,920
8. ME: Median Gross Income	--	--	101,450	103,820	130,270	84,540
9. HCFA: Mean Deductions	39,592	61,300	54,540	56,275	62,383	44,744
10. AMA: Mean Expenses	20,000	36,211	40,390	38,645	45,535	34,558
11. HCFA: Median Deductions	20,009	44,963	44,507	40,001	49,994	37,999
12. ME: Median Expenses	--	--	39,770	35,610	48,590	35,930

report its respondents for each specialty; however, it did report a figure of 4,233 returned questionnaires to its 1977 survey. While not all of these returns represent completed income questions, the order of magnitude is about comparable to the other two surveys.

In Table A-3 the comparable statistics are contained in rows 1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, and 11 and 12. Rows 1 and 2 compare mean net incomes from the HCFA and AMA surveys. For some specialties the HCFA mean lies above the AMA mean, and vice versa; however, in the major discrepant cases of radiology and general surgery, the AMA mean is substantially above the HCFA mean. When median net incomes are compared between the HCFA and AMA surveys, there are some reversals in the rank of net income by specialty. Except for radiology, the medians are fairly close to one another.

As explained above, the Medical Economics question on net income includes "retirement set-asides" (deferred income), so adjusted HCFA net income data, which include estimates of deferred income, in row 5 are compared to ME net incomes in row 6. Of the four specialties compared, the medians tend to be very close, except in the case of OBGYN where the ME median is nearly $5,000 higher. (Note that for this specialty, the AMA and HCFA figures were close to one another.) In the case of gross incomes per MD, rows 7 and 8, the relationship between ME and HCFA medians is variable across specialties.

The greatest systematic discrepancies are in expenses/deductions. The AMA mean expenses are always well below the HCFA mean deductions, and the ME median expenses are always below the HCFA median deductions. Does this suggest that the HCFA deductions are inflated; and, if so, is it because of the differences in terminology between the HCFA and other surveys (i.e., "deductions" vs "expenses") or is it due to some other reason? Furthermore, are these systematic differences in expenses/deductions reflected in net income figures; that is, if there is an upward bias in the HCFA deductions data, does this suggest a downward bias in the net income data? These questions cannot be answered in this appendix, but they are certainly worthy of additional investigation.

Based on Table A-3, one could not conclude that HCFA net incomes tend to be systematically below those reported by other survey organizations. However, even though differences may be explained, in part, by different survey techniques, questions, and chance, there are some discrepant cases that are worthy of further investigation. Radiology is a good example. . . why do HCFA data indicate net incomes of radiologists substantially below those reported by the AMA? The other major difference was in mean net incomes of surgeons, but this difference disappeared in the medians. The ME net incomes are not substantially above comparable HCFA data but, as suggested above, the ME figures may be understated relative to the HCFA adjusted net incomes because the former survey probably includes more physicians with relatively short work weeks. The major apparent discrepancy is in the area of expenses/deductions, where HCFA figures tend to systematically lie above those from the other data sources, regardless of specialty. As suggested above, this may be due to terminology differences, but other possible reasons ought to be explored.

CONCLUSION

It has not been our intention to criticize the HCFA-NORC survey instrument or to express a lack of confidence in the data. True, there are some potential problems in these data as indicated by internal discrepancies and variances with findings from other surveys. However, the word "potential" should be emphasized, as we were unable to detect anything that constitutes a clear error. Most of the discrepancies can be dealt with internally through performing (what we believe to be) reasonable adjustments to the data; for example, adding the figures on deferred income to net income for the purpose of computing adjusted net income per hour of medical activity. It would clearly be inappropriate to attempt to discredit the HCFA-NORC data because they present findings that are not in accord with conventional wisdom or one's preconceptions. In our view, this is worse than uncritical acceptance. The HCFA-NORC data are a valuable source of research information on physicians' practices, probably the most reliable in existence today, and we are glad to have had the opportunity to utilize these data. In sum, while there is cause for some critical examination of the instrument, data collection techniques, sample selection methods, and related factors, there is not sufficient cause to be in any way reluctant to use these data for research purposes.

APPENDIX B

Empirical Findings on Physicians' Service Composition

Frank A. Sloan

INTRODUCTION

This empirical analysis of service composition has two major objectives. First, increases in physician supply may induce physicians to provide services heretofore not emphasized by practicing physicians. For example, Reinhardt(1978) and others have suggested that physician-induced demand is most likely for procedures requiring little or no physician time. Certainly lab tests and x-rays fall in this category. Many observers contend that inducement becomes prevalent in areas with high levels of physician availability relative to population.

It is also possible that the site of care changes in response to increases in physician availability. For example, home visits may be provided by the physician as an amenity. Clearly physicians do not find this type of care very profitable, per se, or, for that matter, professionally rewarding; nor are they necessarily desirable from the vantage point of quality. Yet physicians may perform them to generate good will. As the physician's demand curve shifts inward because new physicians have entered his market area, he may be more likely to provide home care, among other amenities. A number of recent articles in Medical Economics imply this kind of response.[1]

Nursing home-extended care facility and outpatient department-emergency room visits are also not likely to be the physician's "cup-of-tea." However, it is not possible to determine the impact of physician density a priori. On the one hand, as the individual physician's demand curve shifts inward because of a rise in the area physician-population ratio, he will look around for "new business," implying that the physician-population ratio should have a positive impact on these kinds of visits. On the other hand, there may be "specialists" in such services as emergency room care in communities densely populated with physicians. The sign of the relationship will have to be determined on an empirical basis.

Although the specialties are reasonably well-defined in principle, in actuality the content of practice within a specialty seems to vary widely, depending on physician availability, among other factors.[2] For example, it is plausible to expect general-family practitioners to be more likely to engage in office and in-hospital surgery when GPs-FPs are comparatively numerous relative to surgeons. Data from the two HCFA-NORC surveys allow one to test this hypothesis.

A second theme to be investigated in this appendix involves physicians' responses to the malpractice insurance "crisis." Unfortunately, data on the probability of being sued or on the distribution of losses are not available by location for any year even close to the dates of the two physician surveys. Fortunately, data used in previous chapters on malpractice premiums by year, state, and specialty are available. As already indicated, there is reason to believe that premium levels do not relate closely to historical patterns in the risk of being sued or in the size of settlements. Yet, to the extent that premiums rise, we have already seen that the quantity of malpractice insurance falls. Although the relationship between malpractice insurance and self-protective acts on the part of the physician cannot be deduced on the basis of formal economic theory, the hunch of most observers in the field would be that insurance and self-protection are substitutes. That is, as insurance coverage falls as the result of higher premiums, among other factors, physicians engage increasingly in "defensive medicine." Among such defensive acts are (1) increased testing and (2) changes in the mix of services provided. Physicians accordingly would eschew services involving relatively high probabilities of malpractice suits, such as hospital inpatient care in general and surgery in particular.

The next section examines results of regression analysis of the percentage of physician office visits in which the physician stated a laboratory test, x-ray fluoroscopy, or office surgery is performed. Then we discuss empirical findings on determinants of physician provision of in-hospital surgery and provision of care in the home, emergency room-hospital outpatient clinic, and nursing home-extended care facility. The final section presents brief conclusions. As general comment, empirical analysis in this particular area does not prove successful. Thus, we have limited the empirical analysis to ordinary least squares (OLS) although a more complex technique such as Tobit analysis would have been more appropriate. In our experience Tobit never produces markedly different results from OLS; and, in view of the statistical findings from OLS, the cost of the extra investment far exceeds the likely payoff. Furthermore, Tobit results are more difficult to interpret.

PREVALENCE OF LABORATORY TESTS, X-RAYS, AND SURGERY IN PHYSICIAN OFFICE SETTINGS

Both 1977 and 1978 HCFA-NORC surveys asked physicians in all office-based specialties the following question: "During the last week, for approximately what percentage of your office visits did you order a: lab procedure or test; injection or immunization; x-ray or fluoroscopy; office surgical treatment?" The question is limited to office practice, which is not necessarily indicative of the practice as a whole.

Table B-1 presents regressions with percentages of office visits with laboratory procedure test, x-ray or fluoroscopy, and office surgical treatment as the dependent variables. Office surgery and x-ray and fluoroscopy are relatively uncommon, occurring in only 5.1 percent and 13.8 percent of office visits, respectively. By contrast, there is a lab procedure or test in 31.8 percent of such visits.

Overall, considering the R^2s and levels of statistical significance, the equations' degree of explanatory power is reasonably satisfactory. However, most of the explanation comes from casemix-oriented variables. More specifically, virtually all of the coefficients on the specialty dummies are statistically significant at the one percent level. This in itself is hardly surprising, but better results on other explanatory variables were anticipated.

Neither physician availability nor malpractice premiums have impacts on the dependent variables. Nor is a third party reimbursement effect discernable. Health insurance proved to have explanatory power in earlier chapters. Using a somewhat different specification, a logit estimator, but the same data base, Munch (1980) obtained similar results on insurance for physicians' services and physician supply. She too was puzzled by the behavior of the health insurance variables. She experimented with alternative malpractice insurance variables, actual premium/liability limit, the increase in the premium between 1975 and 1976, the upper limit on coverage in 1976, and the increase in that limit between 1975 and 1976. The first measure, actual premium paid per dollar of coverage performed the best; in fact, she found that physicians who pay high dollars of coverage per liability limit order laboratory tests more frequently. There is no reason to believe her measure is better than ours. Our failure to find a definite impact of the premium for a standard level of coverage, \$100,000/\$300,000, casts some doubt on her earlier finding.

There is a suggestion from Table B-1 that as nonphysician wages rise, the

Table B-1: Provision of Laboratory Tests, X-ray-Fluoroscopy, and Surgery in the Physician's Office

	Percentage of Office Visits With		
Specialty	Laboratory Test	X-ray or Fluoroscopy	Office Surgery
Allergy	-2.59	-2.85[c]	-3.99[a]
	(2.72)	(1.66)	(0.86)
Cardiovascular disease	18.06[a]	17.56[a]	-4.11[a]
	(2.95)	(1.80)	(0.95)
Dermatology	-12.50[a]	-6.96[a]	24.13[a]
	(2.73)	(1.65)	(8.68)
Gastroenterology	18.34[a]	19.62[a]	0.14
	(3.22)	(1.95)	(1.02)
General surgery	-6.10[a]	5.81[a]	4.77[a]
	(1.83)	(1.11)	(0.58)
Internal medicine	14.22[a]	8.50[a]	-3.47[a]
	(1.77)	(1.07)	(0.56)
Neurological surgery	-9.53[a]	19.78[a]	-4.25[a]
	(2.76)	(1.67)	(0.88)
Obstetrics-gynecology	23.88[a]	-5.42[a]	-0.20
	(1.98)	(1.20)	(0.63)
Ophthalomology	-21.02[a]	-8.58[a]	-1.00
	(2.41)	(1.46)	(0.77)
Orthopedic surgery	-17.38[a]	40.59[a]	0.15
	(2.63)	(1.60)	(0.84)
Otoloryngology	-9.43[a]	2.16	0.98
	(2.53)	(1.53)	(0.80)
Pediatrics and pediatric surgery	0.12	-3.69[a]	-2.29[a]
	(1.86)	(1.13)	(0.59)
Urology	33.17[a]	6.02[a]	6.18[a]
	(2.66)	(1.61)	(0.85)
Other Physician and Practice Characteristics			
Board certified	0.04	-0.41	0.22
	(0.97)	(0.59)	(0.31)
Distinguished U.S. med. school	2.73	0.23	0.12
	(11.65)	(0.70)	(0.37)
Undistinguished U.S. med. school	1.88	0.47	-0.41
	(1.33)	(0.81)	(0.42)
Distinguished foreign med. school	1.75	-1.27	0.32
	(2.86)	(1.73)	(0.91)
"Third-World" foreign med. school	-0.51	0.53	-0.59
	(1.56)	(0.95)	(0.49)
Other foreign med. school	1.44	-0.31	0.52
	(1.88)	(0.31)	(0.99)
Less than 10 years experience	-0.91	-0.78	-0.28
	(1.76)	(1.06)	(0.56)

Table B-1 (continued)

Specialty	Percentage of Office Visits With Laboratory Test	X-ray Fluoroscopy	Office Surgery
More than 35 years experience	-2.56	-0.84	0.09[b]
	(1.31)	(0.79)	(0.04)
Female MD	-0.82	-0.33	0.71
	(1.76)	(1.07)	(0.56)
Married MD	1.56	1.07	0.14
	(1.52)	(0.93)	(0.49)
No. of children of MD, 18 yrs. or less	-0.20	-0.21	-0.05
	(0.32)	(0.19)	(0.10)
Income from non-med. sources over $10K	-2.62[a]	-0.50	-0.26
	(1.21)	(0.74)	(0.39)
Characteristics of MD's Hospital			
Affiliated with med. school hospital	0.77	0.12	0.44
	(1.00)	(0.60)	(0.32)
Affiliated with ltd. teaching hospital[e]	1.20	-0.47	-0.14
	(1.87)	(1.11)	(0.59)
No primary hospital affiliation	-0.13	-2.42	-2.75[a]
	(2.81)	(1.69)	(0.90)
Area Product Demand			
Physicians per 10,000 population	0.0004	0.0008	-0.0002
	(0.004)	(0.002)	(0.001)
Per capita income	0.0016[a]	-0.0004	0.0003
	(0.0006)	(0.0004)	(0.0002)
Percent private insurance	-0.0067	0.049[c]	-0.019
	(0.047)	(0.029)	(0.015)
Percent Medicare	0.055	0.11[a]	-0.023
	(0.052)	(0.03)	(0.017)
Percent Medicaid (actual)	0.055	0.14[a]	-0.004
	(0.062)	(0.04)	(0.020)
Factor Prices			
Hospital wage (weekly)	-0.035[b]	-0.021[b]	-0.0040
	(0.015)	(0.009)	(0.005)
Rent (annual)	-0.0030[a]	-0.0001	-0.0000
	(0.0010)	(0.001)	(0.0001)
Malpractice premium (annual)	-0.00016	0.0001	-0.0000[d]
	(0.00017)	(0.0001)	(0.0000)
Constant	2.87	9.80	5.26
	(--)	(--)	(--)
	R^2=0.22	R^2=0.32	R^2=0.27
	F(36,3836) = 30.0	F(36,3814) = 50.3	F(36,3826) = 38.4

Notes:
a = Statistically significant at one percent level (two-tailed test).
b = Statistically sitnificant at five percent level (two-tailed test).
c = Statistically significant at ten percent level (two tailed test).
d = t-value is 0.04.
e = ltd. stands for limited. These hospitals have residents but no formal medical school affiliation.

propensity to order tests and x-rays falls. Although interesting, it would not be advisable to push this result too far.

DETERMINANTS OF PROVISION OF INPATIENT SURGERY AND SERVICE AT THE PATIENT'S HOME, EMERGENCY ROOM-HOSPITAL OUTPATIENT CLINIC, AND NURSING HOME-EXTENDED CARE FACILITY

According to the responses from the 1977 and 1978 HCFA-NORC surveys, 36.4 percent of general-family practitioners provided some surgery or a surgical assist during the week preceding the survey interview. Of those with surgical operations and/or assists, the mean number of operations-assists was 3.4. With both numbers, one may readily calculate the mean number of surgical operations-assists per week per general-family practitioner, which is 1.2. Thus, on the whole, GP-FPs are no longer major suppliers of inpatient surgery.

Table B-2 presents two regressions, one for the probability that a general or family practitioner does surgery--one for a GP-FP who performed at least one operation or assist during the reference week and zero otherwise. The other dependent variable is the number of operations-assists provided by GPs-FPs; observations for the second regression are limited to physicians who performed at least one operation or assist during the reference week. The regressions contain one new explanatory variable, the ratio of surgical specialists to general-family practitioners.

Compared to the previous regressions which contain a set of binary variables designating physician specialty, the Table B-2 regressions are poor in terms of statistically significant variables. The ratio of surgical specialists to GP-FPs is of particular interest for purposes of determining the impact of physician specialty mix on the propensity of GP-FPs to perform surgery. The

Table B-2: Provision of In-Hospital Surgery: General Practitioners

Explanatory Variable	Probability GP-FP does surgery	Number of Operations and assists[d]
Board certified	0.11[a]	-0.21
	(0.04)	(0.44)
Distinguished U.S. med. school	0.096[b]	0.70
	(0.047)	(0.49)
Undistinguished U.S. med. school	0.059	0.25
	(0.052)	(0.04)
Distinguished foreign med. school	0.096	1.55
	(0.15)	(1.52)
"Third World" foreign med. school	0.058	1.39[c]
	(0.068)	(0.75)
Other foreign med. school	-0.051	0.54
	(0.12)	(1.76)
Less than 10 years experience	0.002	0.48
	(0.074)	(0.83)
More than 35 years experience	-0.018	0.87
	(0.047)	(0.56)
Female MD	-0.061	-0.09
	(0.065)	(0.83)
Married MD	0.068	-0.37
	(0.054)	(0.69)
Number of children of MD, 18 yrs. or less	0.007	(0.13
	(0.014)	(0.16)
Affiliated with med. school hospital	-0.16[a]	-0.56
	(0.05)	(0.70)
Affiliated with ltd. teaching hospital	-0.084	-1.52[c]
	(0.074)	(0.93)
No primary hospital affiliation	-0.38[a]	--
	(0.09)	(--)
Physicians per 10,000 population	0.0028	-0.0024
	(0.0019)	(0.0026)
Ratio of surgical specialists to GP-FPs	-0.026[c]	0.21
	(0.015)	(0.19)
Per capita income	0.00007[b]	0.00006
	(0.00003)	(0.0004)
Percent private insurance	0.0003	0.0039
	(0.002)	(0.0021)
Percent Medicare	-0.0004	-0.0003
	(0.002)	(0.0002)
Percent Medicaid (actual)	-0.0026	-0.0058
	(0.0023)	(0.029)
Hospital wage (weekly)	-0.0028[a]	0.0021
	(0.0006)	(0.007)
Rent (annual)	-0.00024[a]	-0.0003
	(0.00006)	(0.0008)
Malpractice premium (annual)	0.00020[a]	-0.0003
	(0.00002)	(0.0003)
Constant	0.58	3.74
	(--)	(--)
	$R^2 = 0.24$	$R^2 = 0.08$
	F(24,612) = 8.1	F(23,208) = 0.8

estimated coefficient from the first regression implies that as surgeons become more numerous relative to GP-FPs, the latter become less likely to perform in-hospital surgery. However, for those GP-FPs who perform surgery and/or assists, surgeon availability has no effect on the frequency of operations or assists performed.

The malpractice premium parameter estimate in the first regression is unexpected. It suggested that as premiums rise, GP-FPs become more likely to perform surgery. Clearly, this variable is picking up the influence of some omitted factor.

Table B-3 shows descriptive statistics on the probability that a physician provided care in the home, emergency-hospital outpatient clinic, and/or nursing-home extended care facility during the survey's reference week and the number of visits provided during the week for those physicians who provided any services at the site. Unlike Table B-2, Tables B-3 and B-4 are based on observations from all office-based physician fields.

Table B-3 indicates that, by the late 1970s, provision of home visits was rare. Nursing home-extended care visits were provided by a small proportion of physicians, 0.18, but the mean number of visits per week provided by the 0.18 is only 3.4. Almost half the doctor respondents to the two surveys reported some emergency room-outpatient clinic care for the reference week.

Table B-4 presents six regressions, three for the probability of provision and three for services provided. As with Table B-1, many coefficients on specialty dummy variables are statistically significant. However, no consistent patterns are evident from examining the physician-population ratio coefficients nor those for the malpractice premium.

Table B-3: Means and Standard Deviations: Mix of Services[a]

Service	Probability of Provision	Number for those Providing Service
Home visits	0.15 (0.36)	3.44 (4.97)
Emergency room-hospital out-patient clinic visits	0.46 (0.50)	11.09 (15.67)
Nursing home-extended care visits	0.18 (0.38)	9.89 (16.74)

Note:

[a] Standard deviations are in parentheses.

Table B-4: Mix of Services: Probability of Provision and Average Numbers of Services Provided

Explanatory Variable	Probability of Provision			Number for those Providing		
	Home	ER-Clinic	Nursing Home-ECF	Home	ER-Clinic	Nursing Home-ECF
Specialty						
Allergy	-0.23^a	0.90^a	-0.19^a	-1.40	4.69^b	-5.77
	(0.03)	(0.04)	(0.03)	(2.20)	(2.37)	(4.85)
Cardiovascular disease	-0.25^a	0.05	-0.21^a	-2.89^b	-1.93	-10.38^a
	(0.03)	(0.05)	(0.04)	(1.45)	(2.46)	(3.97)
Dermatology	-0.16^a	-0.14^a	-0.07^b	-3.20^b	4.44	-9.53^a
	(0.03)	(0.04)	(0.03)	(1.33)	(3.74)	(3.25)
Gastroenterology	-0.23^a	0.16^a	-0.23^a	-2.65	-0.59	-10.66^a
	(0.04)	(0.05)	(0.04)	(1.68)	(2.42)	(5.35)
General surgery	-0.24^a	0.34^a	-0.19^a	-0.78	0.80	-2.41
	(0.02)	(0.03)	(0.02)	(0.87)	(1.30)	(2.37)
Internal medicine	-0.02	0.11^a	0.07^a	-1.79^a	-3.57^a	-5.38^a
	(0.02)	(0.03)	(0.02)	(0.51)	(1.39)	(1.57)
Neurological surgery	-0.28^a	0.27^a	-0.28^a	-1.91	-2.84	-7.99
	(0.02)	(0.05)	(0.02)	(3.44)	(1.98)	(7.38)
Obstetrics-gynecology	-0.25^a	0.14^a	-0.28^a	2.53^c	-0.98	1.02
	(0.02)	(0.03)	(0.02)	(1.40)	(1.54)	(4.86)
Ophthalomology	-0.28^a	-0.13^a	-0.25^a	-2.45^c	-4.68^b	-10.78^a
	(0.03)	(0.04)	(0.03)	(1.46)	(2.21)	(3.84)
Orthopedic surgery	-0.25^a	0.46^a	-0.17^a	-1.00	3.43^c	-4.65
	(0.03)	(0.04)	(0.03)	(1.80)	(1.80)	(3.85)
Otolaryngology	-0.26^a	0.27^a	-0.30^a	-1.21	-1.36	-0.92
	(0.03)	(0.04)	(0.03)	(1.92)	(1.88)	(6.83)
Pediatrics and pediatric surgery	-0.16^a	0.14^a	-0.26^a	0.55	0.46	-0.20
	(0.02)	(0.03)	(0.02)	(0.79)	(1.40)	(5.16)
Urology	-0.25^a	0.22^a	-0.21^a	-2.51^c	-5.22	-10.38^a
	(0.03)	(0.04)	(0.03)	(1.40)	(2.01)	(3.53)
Other Physician and Practice Characteristics						
Board certified	-0.02^b	0.09^a	0.02	-1.38^a	-0.52	-2.50^b
	(0.01)	(0.02)	(0.02)	(0.40)	(0.75)	(1.22)
Distinguished U.S. med. school	0.01	0.04^b	-0.0011	0.57	-0.48	0.51
	(0.01)	(0.02)	(0.014)	(0.48)	(0.89)	(1.50)

Table B -4 (continued)

Explanatory Variable	Probability of Provision: Home	Probability of Provision: ER-Clinic	Probability of Provision: Nursing Home-ECF	Number for those Providing: Home	Number for those Providing: ER-Clinic	Number for those Providing: Nursing Home-ECF
Undistinguished U.S. med. school	0.01	0.03	0.02	0.47	-0.57	-0.037
	(0.02)	(0.02)	(0.02)	(0.55)	(1.03)	(1.73)
Distinguished foreign med. school	-0.005	0.06	0.01	-0.83	-4.16^{b}	-0.046
	(0.032)	(0.04)	(0.03)	(1.22)	(2.13)	(3.75)
"Third World" foreign med. school	-0.03	0.04	0.004	-0.13	-0.75	1.33
	(0.02)	(0.02)	(0.019)	(0.73)	(1.16)	(2.11)
Other foreign med. school	-0.05	-0.01	-0.02	-0.63	-1.34	3.00
	(0.03)	(0.05)	(0.04)	(1.32)	(2.50)	(4.27)
Less than 10 years experience	-0.02	0.03	-0.00	-0.67	-0.94	-1.80
	(0.02)	(0.03)	(0.00)	(0.80)	(1.29)	(2.37)
More than 35 years experience	0.02^{c}	-0.06^{a}	0.03^{a}	0.91^{c}	0.95	-0.74
	(0.01)	(0.02)	(0.01)	(0.48)	(0.99)	(1.50)
Incorporated, 6 or more physicians	-0.08^{b}	0.09^{b}	-0.01	-2.10	1.11	2.65
	(0.03)	(0.04)	(0.03)	(1.57)	(1.94)	(3.66)
Incorporated, 2 to 5 physicians	-0.05^{a}	0.05^{b}	-0.03^{c}	-0.32	0.45	4.71^{a}
	(0.01)	(0.02)	(0.01)	(0.60)	(0.90)	(1.74)
Incorporated, solo	-0.04^{a}	0.01	-0.03^{b}	-0.85^{c}	-0.42	-0.50
	(0.01)	(0.02)	(0.01)	(0.51)	(0.93)	(1.50)
Unincorporated, 2 or more physicians	0.01	0.11	0.04^{c}	-1.04	-0.46	1.05
	(0.02)	(0.03)	(0.02)	(0.65)	(1.23)	(2.03)
Female MD	0.08^{a}	-0.03	0.02	-1.31^{c}	1.19	-1.48
	(0.02)	(0.03)	(0.02)	(0.70)	(1.40)	(2.16)
Characteristics of MD's Hospital						
Affiliated with med. school hospital	-0.01	-0.10^{a}	-0.03^{b}	0.001	0.14	-1.24
	(0.01)	(0.02)	(0.01)	(0.44)	(0.78)	(1.35)
Affiliated with ltd. teaching hospital	0.03	-0.10^{a}	-0.01	0.68	-0.49	-0.62
	(0.02)	(0.03)	(0.023)	(0.75)	(1.53)	(2.39)
No primary hospital affiliation	-0.15^{a}	-0.29^{a}	-0.15^{a}	2.97^{a}	5.85^{c}	0.27
	(0.02)	(0.03)	(0.02)	(1.03)	(3.32)	(3.21)
Area Product Demand						
Physicians per 10,000 population	-0.00004	0.0004	-0.00013^{a}	0.005	0.056^{b}	-0.0007
	(0.0004)	(0.0005)	(0.00004)	(0.013)	(0.026)	(0.005)
Per capita income	-0.000003	-0.000004	0.000009	-0.0001	-0.0019^{a}	0.0002
	(0.00001)	(0.00001)	(0.000005)	(0.0003)	(0.0005)	(0.0009)
Percent private insurance	-0.0009^{c}	-0.0012^{c}	-0.0001	0.0031	0.039	0.063
	(0.0005)	(0.0007)	(0.0005)	(0.018)	(0.036)	(0.060)

Table B-4 (continued)

Explanatory Variable	Probability of Provision			Number for those Providing		
	Home	ER-Clinic	Nursing Home-ECF	Home	ER-Clinic	Nursing Home-ECF
Percent Medicare	0.0017^a	-0.00011	0.0022^a	0.045^c	0.078^c	0.16^a
	(0.0005)	(0.0008)	(0.0006)	(0.010)	(0.041)	(0.06)
Percent Medicaid (actual)	-0.0007	0.0002	0.0005	0.025	0.18^a	0.27^a
	(0.0007)	(0.0009)	(0.0007)	(0.025)	(0.05)	(0.08)
Factor Prices						
Hospital wage (weekly)	-0.0004^b	-0.0008^a	-0.0005^b	0.007	-0.0057	0.045^b
	(0.0002)	(0.0002)	(0.0002)	(0.007)	(0.0125)	(0.021)
Rent (annual)	-0.00000	-0.00002	0.000009	0.0007	0.0021^b	-0.0009
	(0.00001)	(0.00002)	(0.00002)	(0.0006)	(0.0010)	(0.0019)
Malpractice premium (actual)	0.000002	-0.000011^a	0.000003	-0.0012	-0.0003^b	-0.0007^a
	(0.000002)	(0.000003)	(0.000002)	(0.0010)	(0.0001)	(0.0003)
Constant	0.45	0.67	0.32	1.17	14.88	-1.64
	(--)	(--)	(--)	(--)	(--)	(--)
	$R^2 = 0.14$	$R^2 = 0.13$	$R^2 = 0.16$	$R^2 = 0.12$	$R^2 = 0.05$	$R^2 = 0.10$
	F(37,4488) = 19.5	F(37,4450) = 17.5	F(37,4486) = 23.0	F(37,660) = 2.4	F(37,2039) = 2.7	F(37,783) = 2.3

Notes:

a = Statistically significant at one percent level (two-tailed test).
b = Statistically significant at five percent level (two-tailed test).
c = Statistically significant at ten percent level (two-tailed test).

CONCLUSIONS AND IMPLICATIONS

Empirical analysis of determinants of physicians' service composition, based on data from the two HCFA-NORC surveys, has not proved very worthwhile. Effects of physician supply and malpractice premiums on either use of ancillary services or on mix of services are not evident. However, it is somewhat premature to conclude that these factors have no effect. In particular, more careful questioning on physician prescribing patterns may reveal important links between physician availability and malpractice premiums and other explanatory influences on prescribing patterns. It is difficult to accept the conclusion that only such factors as physician specialty matter.

APPENDIX C

Further Empirical Evidence on Medicaid and Blue Shield Payment Levels

Frank A. Sloan

ble C-1: Medicaid Payment Le

ary Sampling it	Followup Hospital Visit Usual Fee Mean	CV	N	Medicaid Mean	CV	N	% Usu
NG LAND							
w Britain, CT	$12.18	34.	6	$ 9.13	26.	6	75.
ringfield, Chico- pee, Holyoke, MA	12.08	22.	37	8.03	23.	35	66.
ittenden Co., VT	12.62	19.	15	8.37	20.	15	66.
ATLANTIC							
outh, NJ	14.88	34.	33	7.45	24.	31	50.
ark, NJ	14.09	37.	38	8.83	33.	29	63.
ffalo, NY	11.70	35.	31	5.90	22.	29	50.
w York, NY	15.21	31.	32	5.92	32.	20	39.
w York, NY	15.94	32.	123	5.32	30.	81	33.
racuse, NY	12.15	22.	26	6.36	24.	22	52.
mstrong, Co., PA	16.84	37.	6	6.03	14.	6	36.
ncaster Co., PA	11.64	48.	45	6.49	31.	35	56.
iladelphia, PA	12.27	29.	14	5.72	33.	9	47.
iladelphia, PA	13.55	36.	47	5.63	44.	35	42
ttsburgh, PA	13.10	45.	33	5.29	39.	25	40.
ading, PA	11.59	33.	32	5.00	23.	24	43.
counties[1]	14.54	44.	12	6.81	42.	10	47.
NORTH CENTRAL							
icago, IL	13.93	42.	24	8.43	53.	20	61
troit, MI	14.40	21.	26	9.11	25.	24	63.
int, MI	11.88	32.	30	8.66	26.	22	73
lumbus, OH	11.43	21.	22	9.28	24.	14	81
NORTH CENTRAL							
rris Co., KS							
peka, KS	13.45	34.	9	11.84	26.	8	88
rroll, MO							
. Louis, MO	13.07	33.	29	6.96	28.	25	53
H ATLANTIC							
lando, FL	15.29	23.	33	8.04	38.	13	53
lanta, GA	16.03	20.	22	8.55	22.	9	53
hnston CO., NC							
lkes, NC							
orence, SC							
rion, WV							
SOUTH CENTRAL							
rmingham, AL	15.58	30.	27	10.22	36.	19	68
rmingham, AL	13.96	23.	55	10.21	49.	35	73
ntsville, AL	12.36	28.	49	7.90	32.	39	64
counties[2]	14.97	29.	28	10.71	20.	24	72
xington, KY	14.09	39.	28	5.40	33.	14	38
uisville, KY	13.91	34.	33	7.91	32.	17	57
counties (I)[3]	11.34	35.	21	12.32	102.	20	109
counties (II)[4]	12.41	32.	21	10.71	120.	17	86
counties (I)[5]	8.73	32.	21	6.52	34.	21	75
counties (II)[6]	11.10	26.	25	5.22	16.	18	47
attanooga, TN	12.82	21.	40	8.20	23.	22	64
oxville, TN	11.30	32.	37	7.09	21.	34	63
mphis, TN	13.69	22.	32	8.98	35.	16	66
shville, TN	11.28	24.	33	8.45	54.	28	75
counties[7]	11.25	43.	20	7.21	30.	18	64
SOUTH CENTRAL							
w Orleans, LA							
chita Falls, TX							
TAIN							
sa, CO	11.93	36.	6	7.77	34.	6	65
eat Falls, MT							
FIC							
esno, CA	16.30	25.	27	9.38	40.	25	58
s Angeles- Long Beach, CA	20.19	31.	42	11.56	38.	39	57
n Diego, CA	18.30	28.	32	9.88	35.	28	54

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udes Bradford, Sullivan, and Wyoming counties.

ludes Cullman, Blount, St. Clair, and Talladega counties.

ludes Lewis, Fleming, Bath, Bourbon, Mason, Nicholas, Harri

ludes Christian, Marshall, Trigg, Lyon, Caldwell, Livingsto

ludes Choctaw, Webster, Clay, Monroe, Chicasaw, and Calhoun

ludes Neshoba, Kemper, Newton, and Lauderdale counties.

ludes Maury, Marshall, Bedford, and Moore counties.

Table C-1: Medicaid Payment Levels

Primary Sampling Unit	Followup Hospital Visit							Followup Office Visit							Hernia Repair							Diagnostic D and C							Complete Blood Count							Electrocardiogram							Medicaid Fee Index
	Usual Fee			Medicaid				Usual Fee			Medicaid				Usual Fee			Medicaid				Usual Fee			Medicaid				Usual Fee			Medicaid				Usual Fee			Medicaid				
	Mean	CV	N	Mean	CV	N	% Usual	Mean	CV	N	Mean	CV	N	% Usual	Mean	CV	N	Mean	CV	N	% Usual	Mean	CV	N	Mean	CV	N	% Usual	Mean	CV	N	Mean	CV	N	% Usual	Mean	CV	N	Mean	CV	N	% Usual	
NEW ENGLAND																																											
New Britain, CT	$12.18	34.	6	$ 9.13	26.	6	75.	$10.42	22.	6	$ 8.17	10.	6	78.	$			$				$			$				$			$				$			$				84
Springfield, Chicopee, Holyoke, MA	12.08	22.	37	8.03	23.	35	66.	11.37	24.	46	7.98	24.	41	70.	279.50	11.	14	194.64	19.	14	70.	132.53	34.	15	76.93	39.	15	58.								25.30	25.	19	14.47	23.	17	57.	96
Crittenden Co., VT	12.62	19.	15	8.37	20.	15	66.	11.56	15.	15	7.87	15.	15	68.															8.87	34.	9	6.91	56.	8	78.	24.08	26.	11	15.21	12.	10	63.	97
MID ATLANTIC																																											
Monmouth, NJ	14.88	34.	33	7.45	24.	31	50.	12.50	28.	34	6.13	17.	30	49.	305.33	37.	9	156.63	29.	8	51.	149.00	56.	14	57.69	45.	13	39.	5.57	26.	14	3.56	54.	9	64.	21.94	22.	17	13.57	16.	14	62.	102
Newark, NJ	14.09	37.	38	8.83	33.	29	63.	12.70	29.	41	6.80	15.	33	54.								152.76	22.	11	46.46	49.	7	30.	5.98	21.	10	2.67	31.	7	45.	20.02	21.	19	11.14	21.	13	56.	102
Buffalo, NY	11.70	35.	31	5.90	22.	29	50.	9.40	24.	33	6.82	23.	30	73.	249.74	7.	9	129.44	21.	8	52.	140.37	17.	15	66.82	20.	12	48.	6.39	30.	6	2.49	39.	6	39.	21.68	18.	10	11.32	11.	9	52.	81
New York, NY	15.21	31.	32	5.92	32.	20	39.	12.69	33.	40	6.20	19.	27	49.																						18.75	28.	18	10.69	25.	12	57.	81
New York, NY	15.94	32.	123	5.32	30.	81	33.	14.11	40.	153	6.29	31.	96	45.	330.92	26.	29	120.55	31.	23	36.	186.70	43.	41	54.10	25.	24	29.	6.53	56.	42	2.24	47.	21	34.	19.55	30.	87	10.43	19.	52	53.	81
Syracuse, NY	12.15	22.	26	6.36	24.	22	52.	11.12	30.	34	7.12	27.	25	64.	303.33	16.	6	146.83	5.	6	48.	146.22	17.	9	54.67	9.	6	37.	9.25	41.	8	4.83	42.	6	52.	22.93	20.	15	14.27	13.	11	62.	81
Armstrong, Co., PA	16.84	37.	6	6.03	14.	6	36.	7.98	7.	6	6.38	11.	6	80.																													49
Lancaster Co., PA	11.64	48.	45	6.49	31.	35	56.	8.16	20.	49	6.19	11.	37	76.	236.67	23.	10	96.35	26.	10	41.	113.62	35.	14	36.11	31.	12	32.								17.01	19.	24	14.34	21.	17	84.	49
Philadelphia, PA	12.27	29.	14	5.72	33.	9	47.	10.46	42.	18	6.20	27.	13	59.																													49
Philadelphia, PA	13.55	36.	47	5.63	44.	35	42.	12.04	31.	65	6.11	35.	44	51.	264.56	34.	14	50.40	70.	12	19.	162.74	34.	21	38.49	81.	14	24.								19.70	21.	31	11.31	33.	20	57.	49
Pittsburgh, PA	13.10	45.	33	5.29	39.	25	40.	11.67	36.	39	6.85	31.	28	59.	276.04	25.	7	117.86	16.	7	43.	141.77	33.	10	31.37	17.	9	22.								21.27	26.	19	9.48	37.	10	45.	49
Reading, PA	11.59	33.	32	5.00	23.	24	43.	8.78	20.	40	5.87	12.	31	67.																						20.88	21.	17	7.57	62.	7	36.	49
PA counties[1]	14.54	44.	12	6.81	42.	10	47.	7.61	22.	19	5.85	17.	14	77.																													49
EAST NORTH CENTRAL																																											
Chicago, IL	13.93	42.	24	8.43	53.	20	61.	11.01	32.	26	6.82	23.	21	62.																						15.36	21.	9	9.93	40.	8	65.	105
Detroit, MI	14.40	21.	26	9.11	25.	24	63.	12.67	20.	26	8.27	23.	23	65.								160.68	22.	9	103.38	21.	9	64.	7.68	71.	12	4.19	35.	11	55.	19.25	12.	19	10.98	22.	15	57.	105
Flint, MI	11.88	32.	30	8.66	26.	22	73.	10.97	20.	36	7.72	12.	22	70.	253.13	26.	10	200.89	16.	7	79.	131.43	27.	17	95.51	22.	13	73.	4.83	35.	11	4.17	41.	7	86.	20.07	14.	19	12.92	26.	15	64.	105
Columbus, OH	11.43	21.	22	9.28	24.	14	81.	11.04	28.	28	10.52	47.	15	95.															7.66	48.	7	7.04	60.	6	92.	19.85	21.	16	13.81	23.	10	70.	101
WEST NORTH CENTRAL																																											
Morris Co., KS																																											100
Topeka, KS	13.45	34.	9	11.84	26.	8	88.	10.76	12.	9	8.27	5.	7	77.																													100
Carroll, MO																																											83
St. Louis, MO	13.07	33.	29	6.96	28.	25	53.	10.55	23.	31	6.83	17.	25	65.	279.69	37.	10	179.56	46.	8	64.	141.67	32.	10	68.01	54.	7	48.	7.50	46.	10	6.77	54.	10	90.	17.85	15.	15	13.19	37.	12	74.	83
SOUTH ATLANTIC																																											
Orlando, FL	15.29	23.	33	8.04	38.	13	53.	13.23	21.	36	9.47	20.	15	72.																													97
Atlanta, GA	16.03	20.	22	8.55	22.	9	53.	13.47	21.	27	7.08	38.	9	53.																						18.50	17.	12	10.99	40.	6	59.	131
Johnston Co., NC								10.36	21.	10	8.53	24.	6	82.																													104
Wilkes, NC																																											104
Florence, SC																																											115
Marion, WV																																											75
EAST SOUTH CENTRAL																																											
Birmingham, AL	15.58	30.	27	10.22	36.	19	68.	13.16	43.	29	10.06	35.	20	76.	334.38	19.	11	264.60	32.	10	79.	181.65	20.	14	93.68	43.	12	52.	9.54	33.	20	5.92	34.	13	62.	23.73	21.	14	16.67	28.	10	70.	133
Birmingham, AL	13.98	23.	55	10.21	49.	35	73.	13.18	31.	58	8.60	31.	33	65.	307.38	19.	19	169.17	29.	11	55.	168.19	30.	31	134.42	22.	19	80.	9.21	33.	42	5.22	63.	24	57.	21.87	19.	32	18.17	21.	21	83.	133
Huntsville, AL	12.36	28.	49	7.90	32.	39	64.	10.27	28.	49	7.78	29.	38	76.	288.89	25.	9	198.23	36.	9	69.	137.66	31.	21	95.91	31.	15	70.	8.64	31.	30	7.09	32.	25	82.	19.23	24.	[illegible]	15.28	22.	20	79.	133
AL counties[2]	14.97	29.	28	10.71	20.	24	72.	11.59	22.	30	9.57	25.	24	83.	317.52	18.	14	264.83	19.	11	83.	146.94	52.	21	132.87	37.	18	90.	9.11	35.	24	9.88	78.	20	108.	19.89	40.	24	13.16	27.	19	66.	133
Lexington, KY	14.09	39.	28	5.40	33.	14	38.	12.18	22.	25	5.95	38.	14	49.																						18.96	18.	15	10.69	47.	8	56.	102
Louisville, KY	13.91	34.	33	7.91	32.	17	57.	11.15	18.	31	8.89	25.	15	80.															6.49	24.	19	4.58	35.	[illegible]	71.	17.64	13.	16	11.75	24.	7	67.	102
KY counties (I)[3]	11.34	35.	21	12.32	102.	20	109.	7.82	27.	21	5.62	20.	18	72.	323.81	20.	8	68.30	12.	8	21.	118.71	35.	14	51.28	24.	14	43.	7.26	24.	10	6.08	18.	9	84.	18.45	22.	10	13.23	15.	9	72.	102
KY counties (II)[4]	12.41	32.	21	10.71	120.	17	86.	9.92	33.	24	5.83	21.	19	59.															7.62	40.	10	5.80	46.	8	76.	16.89	17.	16	11.90	33.	12	70.	102
MS counties (I)[5]	8.73	32.	21	6.52	34.	21	75.	8.16	25.	21	6.52	16.	21	80.	293.25	23.	[illegible]	157.54	31.	[illegible]	54.	125.12	40.	10	73.57	33.	10	59.	9.96	58.	11	8.33	45.	11	84.	18.86	30.	13	13.55	8.	13	72.	61
MS counties (II)[6]	11.10	26.	25	5.22	16.	18	47.	10.71	23.	25	6.75	12.	18	63.	327.38	25.	11	158.77	28.	11	48.	142.43	49.	14	45.63	32.	9	32.	9.59	46.	19	7.34	52.	12	77.	20.02	41.	11	13.62	26.	9	68.	61
Chattanooga, TN	12.82	21.	40	8.20	23.	22	64.	11.62	18.	44	7.94	33.	22	68.	308.25	13.	11	192.34	19.	6	62.	164.98	27.	17	126.05	23.	9	76.	8.80	40.	23	5.75	45.	13	65.	19.25	22.	20	14.94	19.	14	78.	118
Knoxville, TN	11.30	32.	37	7.09	21.	34	63.	10.38	17.	[illegible]	7.51	17.	33	72.	320.17	11.	8	161.85	42.	7	51.	168.64	18.	15	104.24	35.	11	62.	9.25	30.	28	6.53	34.	24	71.	18.18	14.	22	13.26	18.	21	73.	118
Memphis, TN	13.69	22.	32	8.98	35.	16	66.	12.80	24.	30	9.89	36.	15	77.								169.32	28.	13	90.23	56.	6	53.	8.41	41.	25	4.24	47.	13	50.	17.99	20.	20	12.30	25.	10	68.	118
Nashville, TN	11.28	24.	33	8.45	54.	28	75.	11.28	27.	33	6.95	27.	27	62.	319.02	16.	17	261.50	13.	17	82.	141.93	30.	15	93.23	9.	11	66.	8.74	37.	22	3.01	70.	17	39.	17.66	23.	19	13.11	26.	15	74.	118
TN counties[7]	11.25	43.	20	7.21	30.	18	64.	9.74	39.	22	5.75	18.	18	59.	316.33	27.	7	257.94	14.	6	82.	138.33	35.	10	101.85	42.	9	74.	8.81	34.	15	6.35	39.	12	72.	17.77	30.	13	12.50	24.	10	70.	118
WEST SOUTH CENTRAL																																											
New Orleans, LA								11.36	9.	15	8.66	10.	8	76.																													112
Wichita Falls, TX																																											120
MOUNTAIN																																											
Mesa, CO	11.93	36.	6	7.77	34.	6	65.	10.98	19.	[illegible]	9.66	22.	6	88.																													85
Great Falls, MT																																											97
PACIFIC																																											
Fresno, CA	16.30	25.	27	9.38	40.	25	58.	14.05	25.	34	8.21	26.	31	58.	438.10	11.	7	257.08	11.	8	59.	184.05	15.	14	105.48	13.	14	57.								27.48	19.	15	20.79	36.	14	76.	108
Los Angeles-Long Beach, CA	20.19	31.	42	11.56	38.	39	57.	17.02	24.	44	9.56	29.	39	56.	898.25	29.	8	228.27	32.	11	57.	196.19	28.	18	86.00	48.	16	46.	8.50	20.	22	5.75	40.	20	68.	26.11	23.	28	16.17	24.	24	62.	108
San Diego, CA	18.30	28.	32	9.88	35.	28	54.	14.40	19.	37	8.96	22.	32	62.	448.13	11.	6	250.68	26.	9	56.	191.29	17.	15	95.83	29.	11	50.	9.01	23.	18	6.06	43.	16	67.	24.01	16.	19	16.46	30.	15	69.	108

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[1] Includes Bradford, Sullivan, and Wyoming counties.

[2] Includes Cullman, Blount, St. Clair, and Talladega counties.

[3] Includes Lewis, Fleming, Bath, Bourbon, Mason, Nicholas, Harrison, Bracken, Pendleton, and Robertson counties.

[4] Includes Christian, Marshall, Trigg, Lyon, Caldwell, Livingstone, and Crittenden counties.

[5] Includes Choctaw, Webster, Clay, Monroe, Chicasaw, and Calhoun counties.

[6] Includes Neshoba, Kemper, Newton, and Lauderdale counties.

[7] Includes Maury, Marshall, Bedford, and Moore counties.

We have also correlated the HCFA-NORC physician survey data with unpublished HCFA data from the plans, provided on the NORC tape sent to us by HCFA. Two sets of correlations have been obtained. The two sets of Medicaid rates were created by the HCFA programmers as they ascribed the fee data to category 1 or 2. Neither case by case analysis of the data nor careful reading of the accompanying documentation has illuminated the reasoning behind ascribing a specialty to one or the other of the two sets. The correlations are presented below:

	Set 1	Set 2
followup hospital visit	-0.11	-0.10
followup office visit	-0.30	-0.26
inguinal hernia repair	-0.03	-0.07
diagnostic D and C	-0.04	0.05
complete blood count	0.23	0.25
electrocardiogram	0.12	0.08

These correlations are extremely poor by any standard.

ANALYSIS OF WITHIN-PSU VARIATIONS IN PAYMENTS

In the two papers on Blue Shield and Medicaid payments, some measures of characteristics of the individual physician respondent are included as explanatory variables. We have also estimated regressions for the larger PSUs with the following characteristics as explanatory variables:

SPEC=1	if the physician is a specialist;
BCERT=1	if the physician is board certified in a specialty;
FAC=1	if the physician has a university affiliation;
FMG=1	if the physician graduated from a medical school in a "third world" country;
AGE=1	if the physician was age 60 or over at the time of the survey.

Analysis is limited to these procedures: followup hospital visit (FHV); followup office visit (FOV); and electrocardiogram (EKG). The numbers of valid responses on the other procedures are inadequate for purposes of multivariate analysis on samples of individual PSUs.

Regressions for the following PSUs have been estimated: Birmingham, AL; New York, NY; Buffalo, NY; Syracuse, NY; Detroit, MI; Los Angeles, CA; Louisville, KY; Memphis, TN; Nashville, TN; Newark, NJ; and Pittsburgh, PA. For purposes of these regressions, observations from national and regional PSUs have been combined when they correspond to the same city. Philadelphia was eliminated because the PSU contains physician responses from both Pennsylvania and New Jersey, and it is not possible to differentiate among physicians within PSUs according to state of residence. In the Medicaid and Blue Shield payment papers, we weighted area-specific characteristics by the proportions of doctors in each of the two states (when there was overlap). This approach is not practical for within-PSU analysis.

Table C-2 presents within-PSU regressions. A regression is only presented in the table if the F-value on the regression indicates the overall relationship is statistically significant at the five percent level or better. Most of the regressions have F-values below this. When there are very few or no physicians with a specific characteristic and/or a characteristic makes absolutely no contribution to explained variance, it is excluded from the regression.

An insignificant F on the entire regression suggests (1) the independent variables do not explain much of the variance in the dependent variable, (2) there are insufficient number of observations to permit statistically valid inferences, and/or (3) there is little variation in the dependent variable. Clearly, given the

				Physician Characteristic						
Procedure	Payor	Location	Constant	SPEC	BCERT	FAC	FMG	AGE		
FHV	BS	Birmingham, AL	9.79 (--)	4.89[c] (1.30)	-2.15[c] (1.16)	-0.64 (1.05)	-- (--)	-- (--)	R^2=0.16 R^2(c)=0.13	F(3,73)=4.8
FHV	BS	New York, NY	7.52 (--)	3.31[a] (0.91)	-1.21 (0.95)	-0.12 (1.06)	-1.45[c] (0.86)	-1.31[c] (0.74)	R^2=0.12 R^2(c)=0.08	F(5,114)=3.1
FHV	BS	Los Angeles, CA	13.28 (--)	1.78 (1.86)	-0.51 (1.68)	3.47[b] (1.74)	10.45[b] (4.64)	-- (--)	R^2=0.27 R^2(c)=0.17	F(4,30)=2.8
FHV	MCAID	Birmingham, AL	7.29 (--)	5.09[a] (1.73)	-1.12 (1.70)	-1.86 (1.45)	-- (--)	3.18[b] (1.45)	R^2=0.23 R^2(c)=0.17	F(4,49)=3.7
FHV	MCAID	Buffalo, NY	4.47 (--)	1.87[a] (0.70)	-0.61 (0.63)	0.71 (0.66)	-0.83 (0.67)	0.92[c] (0.55)	R^2=0.47 R^2(c)=0.35	F(5,23)=4.0
FHV	MCAID	Syracuse, NY	7.89 (--)	-2.22[a] (0.67)	-0.58 (0.61)	1.45[b] (0.57)	-0.70 (0.78)	-1.25[c] (0.72)	R^2=0.54 R^2(c)=0.40	F(5,16)=3.8
FOV	BS	Birmingham, AL	5.79 (--)	5.03[b] (2.11)	2.43 (1.73)	-2.81[c] (1.61)	-- (--)	-0.49 (1.82)	R^2=0.29 R^2(c)=0.20	F(4,35)=3.5
FOV	BS	Los Angeles, CA	8.85 (--)	3.68[b] (1.46)	0.47 (1.39)	2.33[c] (1.44)	5.73 (3.69)	-0.73 (1.27)	R^2=0.42 R^2(c)=0.32	F(5,27)=4.0
FOV	BS	Pittsburgh, PA	23.32 (--)	9.11[b] (4.14)	-21.85[a] (5.89)	-- (--)	-10.18[b] (4.19)	-17.33[a] (4.64)	R^2=0.68 R^2(c)=0.53	F(4,8)=4.3
FOV	MCAID	Birmingham, AL	7.34 (--)	1.15 (1.18)	1.60 (1.14)	0.67 (0.98)	-- (--)	0.14 (1.01)	R^2=0.22 R^2(c)=0.15	F(4,48)=3.3
FOV	MCAID	New York, NY	6.40 (--)	1.04 (0.47)	-1.33[a] (0.43)	0.25 (0.46)	-0.16 (0.37)	-0.80[b] (0.40)	R^2=0.13 R^2(c)=0.10	F(5,117)=3.6
FOV	MCAID	Newark, NJ	5.15 (--)	1.63[a] (0.43)	0.43 (0.32)	-- (--)	0.15 (0.35)	0.19 (0.34)	R^2=0.50 R^2(c)=0.43	F(4,28)=7.1
EKG	BS	Birmingham, AL	15.96 (--)	5.38[b] (2.13)	1.17 (1.87)	-0.28 (1.82)	-- (--)	1.60 (1.84)	R^2=0.30 R^2(c)=0.23	F(4,37)=4.0
EKG	BS	Louisville, KY	19.61 (--)	-1.18 (1.08)	-1.37[c] (0.84)	-0.98 (0.75)	-- (--)	3.01[a] (0.66)	R^2=0.90 R^2(c)=0.82	F(4,5)=10.9
EKG	MCAID	Memphis, TN	10.54 (--)	3.64[b] (1.55)	-- (--)	3.07 (2.53)	-- (--)	-- (--)	R^2=0.61 R^2(c)=0.50	F(2,7)=5.6
EKG	MCAID	Nashville, TN	11.05 (--)	1.05 (0.86)	10.12[a] (1.41)	-6.48[a] (1.36)	-0.99 (1.41)	-0.74 (0.80)	R^2=0.92 R^2(c)=0.87	F(5,9)=20.2

Notes:
a. Statistically significant at the 1 percent level (two-tail test).
b. Statistically significant at the 5 percent level (two-tail test).
c. Statistically significant at the 10 percent level (two-tail test).

results shown in Table C-1, the third reason is not applicable here. The second is somewhat important since some of the larger PSUs (or ones with larger numbers of physician respondents) appear in Table C-2 more often. But certainly another reason is that third party payments do not always vary on the basis of the physician characteristics included in the regression.

Among the included characteristics, SPEC tends to be the most important. Signs on SPEC tend to be positive. By contrast, signs on BCERT and FAC vary considerably. The positive FMG coefficients correspond to Los Angeles. Elsewhere, the foreign-trained physicians tend to earn less for performing the three procedures contained in Table C-2.

These regressions "push" the physician survey data about as far as they will go. In the future, it seems advisable to limit this type of within-PSU analysis to data derived from insurer claims files. It is difficult (1) to derive sufficiently large numbers of responses for specific locations, and (2) to define the procedures narrowly enough to eliminate "noise" in surveys of physicians' practices. For many other purposes, surveys of physicians have proven to be quite useful.

APPENDIX D

Administrative Burdens Associated with Collecting Third Party Payments

Frank A. Sloan

INTRODUCTION

The 1975 National Physicians' Administrative Practices Survey requested detailed information from physicians about administrative burdens associated with collecting from and dealing with third party payors. The specific questions on which the analysis presented in this appendix is based are reproduced in Table D-1.

As seen in this table, physicians were first asked about the relevant importance of various insurance programs to their practices. If a physician said more than 2 of the 5 insurance programs listed were not pertinent to his practice, the entire observation has been eliminated from the analysis. Otherwise, we have done nothing with the rankings of insurance programs in order of importance to the practice.

Three types of substantive questions were raised. First, the survey asked the physician to indicate which of the two plans (among those pertinent to his practice) were most likely to return forms for additional work by the physician. For each of the two named plans, the physician was asked to estimate what percent of the time the claim was returned for additional work by his office. Second, the physician was asked which two plans were the slowest in paying him. For each plan identified, the physician was asked to indicate how many months it takes for the named insurer to make the payment on average. Third, the physician was asked to name the two types of claims that take his office the longest to fill out and for these two, to indicate how long it takes to fill out a typical claim form.

The objective of this appendix is to present descriptive and multivariate analysis of the responses pertinent to Medicaid and Blue Shield.

HAND CARD OF
INSURANCE
PROGRAMS

INSURANCE PROGRAMS	A. Of these, which would you say is the most common in (your/Dr.________'s) practice? ENTER "1" AND ASK: Which is the (2nd/3rd/etc.) most common? ENTER "2", ETC. ENTER "9" IF PROGRAM NOT USED.	B. Which 2 of these plans stand out in your mind as being the most likely to be returned for additional work by your office?	C. FOR EACH ONE MENTIONED IN B, ASK: About what percent of the time is a (TYPE OF INSURANCE) claim returned for additional work by your office?	D. Which 2 of these are the slowest in paying (you/Dr.____)?	E. FOR EACH ONE MENTIONED IN D, ASK: As far as you know, how many months does it take (TYPE OF INSURANCE) to make payments?	F. Which 2 types of claims take your office the longest to fill out?	G. FOR EACH ONE MENTIONED IN F, ASK: About how long does it take to fill out a claim for (TYPE OF INSURANCE)?	H. And one la question about clai Which of these plan if any, ha ever paid (you/Dr.__ directly i the last year or so CODE ALL THAT APPLY
1) Blue Sheild	________	1	________ %	1	______ mos.	1	______ min.	1
Commercial Companies (Aetna, Traveler, etc.)	________	2	________ %	2	______ mos.	2	______ min.	2
Independent plans (union sponsored groups, Kaiser, GHI, etc.)	________	3	________ %	3	______ mos.	3	______ min.	3
4) Medicaid	________	4	________ %	4	______ mos.	4	______ min.	4
5) Medicare	________	5	________ %	5	______ mos.	5	______ min.	5
								none

4. About how many insurance claims are filled out by this practice (for Dr. ________'s) patients during a typical week?

__________ claims

NONE 00

COMPLETED BY:

NAME: ____________________

TIME: __________

TITLE: ____________________

It is worth noting that responses to this question were used as independent variables in multivariate analysis of physician participation in Medicaid programs by Sloan, Cromwell, and Mitchell (1978a, 1978b). In that analysis, bureaucratic "hassles" deterred physician participation in state Medicaid programs. Because these variables performed reasonably well as explanatory variables, we proposed to HCFA that work be undertaken to enable us to better understand why administrative burdens vary among insurers and geographic areas. In general, this research has proven to be disappointing, and it is for this reason that presentation of ou results are confined to an appendix.

Unfortunately, very little information is available on administrative burdens imposed on physicians by third parties from other sources. HCFA sent us some estimates of Medicaid payment delays by state for the years 1975 and 1976. Correspondence between HCFA's series and data from this national survey of physicians is quite poor. The HCFA data on the turnabout time in claims processing, available for states with a Medicaid program, imply patient delays in 1976 ranging from 4 days (for Ohio) to 80 days (for Connecticut). By contrast, the mean payment delay in months, based on physicians naming Medicaid as among the two worst insurance programs, was 3.8. Moreover, the simple correlation between payment delays from the two surveys is only 0.19.* Although the questions have not been asked in the same way and sources of data are substantially different, somewhat greater correspondence between the two series was expected.

DESCRIPTIVE EVIDENCE

Tables D-2 and D-3 present estimates of administrative burdens of Medicaid and of Blue Shield, respectively, by Primary Sampling Unit (PSU).

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*With 1976 appointment delay series provided by HCFA.

Primary Sampling Unit	Total Cases	Claim Most Likely to Be Returned for Additional Work		Slowest Paying		Time Spent Filling Out Claim	
		Worst 2 (%)	Percent of Time Claim Returned	Worst 2 (%)	Months it Takes	Worst 2 (%)	Time it T (Min.)
Northeast							
New Britain, CT	5	20.0	50.0 (1)	40.0	2.5 (2)	60.0	7.0 (3)
Springfield, Chicopee, Holyoke, MA	44	68.2	24.4 (28)	88.6	4.5 (37)	65.9	9.6 (27)
Newark, NJ	38	44.7	5.9 (16)	39.5	2.5 (15)	31.6	7.7 (12)
New York, NY	37	51.4	14.4 (19)	64.9	5.3 (24)	56.8	8.9 (19)
Armstrong Co., PA	6	50.0	4.3 (3)	66.7	3.8 (4)	33.3	7.5 (2)
Philadelphia, PA	20	15.0	7.0 (13)	60.0	2.7 (10)	25.0	8.3 (4)
Reading, PA	48	33.3	39.0 (16)	50.0	3.5 (24)	31.3	15.3 (15)
Chittenden, VT	15	86.7	9.9 (13)	73.0	2.4 (11)	33.3	5.3 (4)
North Central							
Chicago, IL	27	66.7	29.1 (16)	74.0	4.6 (19)	51.9	11.9 (13)
Morris, Co., KS	2	100.0	5.5 (2)	50.0	2.0 (1)	0.0	
Topeka, KS	9	22.2	2.0 (1)	44.4	4.3 (4)	55.6	14.0 (5)
Detroit, MI	29	51.7	17.1 (14)	72.4	2.9 (19)	58.6	9.3 (16)
Flint, MI	36	66.7	22.3 (23)	55.6	3.2 (20)	63.9	10.0 (21)
Carroll, MO	3	0.0		66.7	5.5 (2)	0.0	
St. Louis, MO	35	37.1	21.4 (11)	62.9	3.9 (22)	42.9	9.7 (14)
Columbus, OH	27	48.1	32.8 (12)	48.1	4.3 (12)	37.0	9.6 (10)
South							
Birmingham, AL	29	31.0	4.3 (7)	44.8	2.8 (13)	17.2	3.8 (4)
Orlando, FL	32	12.5	10.5 (2)	34.4	3.5 (11)	18.8	14.0 (5)
Atlanta, GA	28	28.6	48.8 (8)	25.0	6.0 (7)	7.1	8.0 (1)
New Orleans, LA	13	7.7	10.0 (1)	30.8	2.0 (4)	38.5	16.0 (4)
Johnston, Co., NC	11	54.5	7.4 (5)	54.5	2.7 (6)	54.5	14.5 (6)
Wilkes, Co., NC	2	0.0		50.0	3.0 (1)	0.0	
Florence, SC	3	100.0	5.3 (3)	66.7	2.0 (2)	33.3	10.0 (1)
Wichita Falls, TX	7	28.6	10.0 (1)	28.6	1.0 (1)	42.9	15.0 (3)
Marion, WV	6	16.7	5.0 (1)	66.7	11.7 (3)	16.7	
West							
Fresno, CA	32	68.8	12.7 (21)	68.8	2.9 (22)	62.5	8.3 (20)
Los Angeles-Long Beach, CA	41	65.9	19.3 (26)	63.4	3.4 (25)	63.4	11.7 (26)
San Diego, CA	38	63.2	12.6 (23)	71.1	3.2 (27)	55.3	13.0 (19)
Mesa, CO	5	80.0	4.0 (3)	80.0	3.0 (4)	60.0	10.0 (3)
Great Falls, MT	4	50.0	15.0 (1)	50.0	2.5 (2)	50.0	3.0 (1)
U.S.	632	47.1	16.1 (290)	57.7	3.8 (354)	42.5	10.9 (258)

Table D-3: Administrative Burdens of Blue Shield

Primary Sampling Unit	Total Cases	Claim Most Likely to Be Returned for Additional Work		Slowest Paying		Time Spent Filling Out Claim	
		Worst 2 (%)	Percent of Time Claim Returned	Worst 2 (%)	Months it Takes	Worst 2 (%)	Time it Takes (Min.)
Northeast							
New Britain, CT	5	80.0	1.5 (4)	60.0	1.3 (3)	40.0	4.0 (2)
Springfield, Chicopee, Holyoke, MA	44	54.5	12.0 (22)	22.7	2.0 (9)	36.4	5.2 (16)
Newark, NJ	38	63.2	4.4 (23)	50.0	2.2 (19)	52.6	8.4 (20)
New York, NY	37	51.4	6.9 (15)	43.2	2.2 (16)	24.3	5.7 (9)
Armstrong Co., PA	6	50.0	3.0 (3)	0.0		16.7	45.0 (1)
Philadelphia, PA	20	55.0	7.6 (10)	20.0	1.3 (3)	35.0	12.6 (7)
Reading, PA	48	62.5	9.5 (30)	33.3	1.2 (15)	31.3	7.5 (15)
Chittenden, VT	15	60.0	5.0 (9)	6.7	1.0 (1)	26.7	5.0 (4)
North Central							
Chicago, IL	27	37.0	8.5 (10)	18.5	2.4 (5)	14.8	8.3 (4)
Morris, Co., KS	2	0.0		0.0		0.0	
Topeka, KS	9	22.2	1.5 (2)	0.0		11.1	10.0 (1)
Detroit, MI	29	44.8	10.3 (13)	27.6	2.1 (8)	27.6	8.3 (8)
Flint, MI	36	58.3	10.6 (19)	38.9	2.3 (14)	25.0	7.7 (7)
Carroll, MO	3	66.6	11.0 (2)	33.3	2.0 (1)	33.3	20.0 (1)
St. Louis, MO	35	45.7	4.1 (14)	40.0	2.3 (14)	34.3	7.3 (12)
Columbus, OH	27	11.1	8.5 (2)	14.8	1.3 (4)	18.5	6.8 (5)
South							
Birmingham, AL	29	55.2	7.3 (14)	58.6	3.5 (16)	20.7	10.4 (5)
Orlando, FL	32	65.6	12.9 (19)	40.6	2.8 (13)	31.3	6.5 (10)
Atlanta, GA	28	53.6	18.1 (14)	42.9	2.0 (12)	42.9	11.1 (12)
New Orleans, LA	13	38.5	15.8 (5)	46.2	2.2 (6)	15.4	3.0 (1)
Johnston, Co., NC	11	27.3	1.0 (2)	18.2	1.0 (1)	27.3	10.7 (3)
Wilkes, Co., NC	2	0.0		50.0	3.0 (1)	0.0	
Florence, SC	3	33.3	3.0 (1)	0.0		0.0	
Wichita Falls, TX	7	14.3	10.0 (1)	28.6	2.0 (2)	14.3	30.0 (1)
Marion, WV	6	16.7		0.0		16.7	7.0 (1)
West							
Fresno, CA	32	21.9	9.4 (5)	18.8	2.8 (5)	15.6	5.2 (5)
Los Angeles-Long Beach, CA	41	39.0	12.5 (15)	48.8	2.5 (20)	41.5	13.0 (17)
San Diego, CA	38	42.1	5.5 (15)	39.5	2.5 (15)	42.1	8.2 (15)
Mesa, CO	5	20.0	5.0 (1)	20.0	2.0 (1)	20.0	10.0 (1)
Great Falls, MT	4	25.0	2.0 (1)	0.0		0.0	
U.S.	632	40.7	8.0 (271)	28.8	2.2 (204)	26.6	9.5 (183)

The number of cases per PSU is given in both tables. Some of the cell sizes are very small, and the reader is advised to exercise appropriate caution. These features of the two tables are noteworthy. First, judging from the means for the United States as a whole, physicians have many more complaints about Medicaid than about Blue Shield. Differences are particularly pronounced in payment delays, where over twice as many physicians complain about Medicaid payment delays. Second, with reference to Table D-2, only rarely is a Medicaid plan worst on all three criteria. On this count, Massachusetts and Illinois appear to be among the worst. Other states, such as New York, stand out in terms of payment delays, but otherwise are reasonably average. Third, in some cases, physicians may be relaying their perceptions and attitudes rather than the reality. For example, it is difficult to believe that in Atlanta, Georgia, forms are returned 49% of the time (including only those who named Medicaid as among the two worst).[1] It is interesting that the same Atlanta physicians seem to have the same problem, only to a lesser degree, with Blue Shield. In this latter case, the percent of time returned is 18.1.

REGRESSIONS

Specification

The specification of the Medicaid regressions presented below is virtually the same as our Medicaid payment level regressions (see Chapter 8) with these exceptions. First, it is likely that Medicaid program variables play a bigger role in explaining administrative burdens than in explaining payments. For this reason, we step in a set of program characteristics variables first. Two new variables are added: ASP, which equals one if the state processes physicians' claims;

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[1] Jimmy Carter was no longer Governor of Georgia at the time the survey was conducted. So one cannot blame him for this one.

AFA, which equals one if claims processing is performed by a private fiscal agent. The excluded category includes states with a mix of state-fiscal agent claims processing. Second, since responses to these administrative burden questions may reflect perceptions in part, variables representing physicians' attitudes are included. The national survey asked the physician whether he agreed strongly, agreed somewhat, disagreed somewhat, or disagreed strongly, with each of two statements. The first statement was, "It is the responsibility of society through its government, to provide everyone with the best available medical care, whether he can afford it or not." If a physician responded "disagree strongly," CON1 equals one. The second attitude question was this: "There are too many controls on the medical profession that interfere with taking care of patients." If the physician agreed strongly, CON2 equals one. Both measures are included to gauge conservatism of the individual physician respondent.

The Blue Shield administrative burden regressions are the same as those for Blue Shield payments (see Chapter 7) with these exceptions. First, the physician control of committees variable (COM) is not included. Second, because physicians may have been more likely to mention Blue Shield if they have considerable contact with it, the Blue Shield market share is included as an explanatory variable. This latter variable is BSMS, the percentage of persons in the Blue Shield Plan Area enrolled in a Blue Shield plan.

Since we regard a low administrative burden associated with collecting third party payments as a form of physician compensation, reduced form equations pertinent for payment regressions should also be relevant for regressions with administrative burden dependent variables.

At least we have taken this as a working hypothesis. If the regression analysis had proved more successful, we might have attempted to alter specifications to a greater extent.

Results

Table D-4 presents administrative burden regressions for Medicaid. We first discuss the Medicaid program characteristics variables. Then, we shall consider the performance of the rest of the explanatory variables.

The program characteristics variables explain a meaningful proportion of the variance in the dependent variable in two regressions, the percent of time the claim is returned for additional work, given that Medicaid has been identified among the two worst programs in this regard, and in the regression for the months it takes the insurer to make payments, again once Medicaid has been indentified as being among the two worst. In the first of these two regressions, relatively efficient program arrangements involve placing the agency in a welfare department, hiring a fiscal agent, and using the Medicare payment system (represented by the variable FT18). This mix of program arrangements would also result in relatively fast payments, with one exception.

Payment delays are shorter for Medicaid programs housed in umbrella agencies than for those in welfare departments. Before concluding that these arrangements are necessarily efficient, however, one should also consult the corresponding regressions with the probability of naming Medicaid as a dependent variable.

Table D-4 Administrative Burden Regressions: Medicaid

	Claim Most Likely to be Returned for Additional Work: Probability Medicaid Mentioned		Percent of Time Claim Returned for Additional Work		Longest Payment Delays: Probability Medicaid Mentioned		Months it Takes to be Paid		Claim Takes Longest to Fill Out: Probability Medicaid Mentioned		Minutes it Takes to Fill Out Form	
AFA	0.060 (0.062)	0.13^{c} (0.07)	-19.03^{a} (3.85)	-21.49^{a} (4.71)	-0.040 (0.061)	-0.040 (0.069)	-0.79 (0.76)	-2.56^{a} (0.84)	0.13^{b} (0.06)	0.19^{a} (0.07)	0.51 (1.76)	-1.45 (2.22)
AST	0.0070 (0.066)	0.00023 (0.07762)	1.27 (4.11)	3.36 (5.16)	-0.0026 (0.065)	0.044 (0.077)	-0.088 (0.776)	-0.50 (0.87)	0.16^{b} (0.064)	0.20^{a} (0.076)	-1.07 (1.74)	-0.94 (2.12)
AHLTH	0.17^{c} (0.09)	-0.25^{c} (0.15)	16.67^{a} (5.16)	15.41 (10.09)	-0.021 (0.091)	-0.13 (0.15)	-3.94^{a} (1.07)	1.98 (1.67)	0.21^{b} (0.09)	-0.097 (0.150)	-0.49 (2.06)	-2.76 (3.86)
AUBLA	-0.031 (0.050)	0.034 (0.058)	1.94 (2.97)	0.65 (3.49)	-0.0092 (0.0495)	-0.020 (0.058)	0.090 (0.617)	-1.01 (0.63)	-0.050 (0.050)	-0.019 (0.057)	2.19^{c} (1.18)	2.24 (1.55)
ASPEC	-0.159^{c} (0.09)	0.048 (0.108)	21.10^{a} (6.46)	17.00^{b} (8.08)	-0.19^{b} (0.09)	-0.11 (0.11)	1.50 (1.45)	0.33 (1.44)	-0.20^{b} (0.09)	-0.069 (0.107)	-4.98 (4.47)	-3.49 (4.78)
FSCHD	-0.0067 (0.066)	0.068 (0.082)	-7.04^{c} (3.89)	-4.63 (4.93)	0.17^{a} (0.065)	0.14^{c} (0.082)	4.37^{a} (0.76)	3.21^{a} (0.88)	-0.041 (0.065)	0.011 (0.080)	-0.54 (1.56)	1.94 (1.94)
FT18	-0.030 (0.075)	0.077 (0.079)	-17.36^{a} (5.32)	-16.51^{a} (5.98)	-0.0038 (0.0738)	0.036 (0.079)	-0.76 (1.00)	-0.83 (0.97)	-0.14^{c} (0.07)	-0.077 (0.077)	-2.15 (2.71)	-3.90 (2.94)
FAC		-0.038 (0.073)		2.26 (4.69)		0.051 (0.073)		-0.25 (0.75)		-0.015 (0.072)		-0.97 (1.72)
SPEC		0.032 (0.050)		1.81 (2.90)		0.068 (0.049)		1.36^{b} (0.57)		-0.0027 (0.0487)		-1.25 (1.22)
BCERT		-0.062 (0.047)		-1.31 (2.84)		-0.0041 (0.0472)		-1.34^{a} (0.51)		0.052 (0.047)		0.83 (1.15)
CON1		-0.015 (0.045)		-0.59 (2.89)		0.022 (0.044)		1.56^{a} (0.50)		0.034 (0.044)		2.28^{b} (1.13)
CON2		-0.0077 (0.0410)		0.93 (2.48)		0.060 (0.041)		-0.26 (0.46)		0.050 (0.040)		0.48 (1.04)
POVP		0.0093 (0.01320)		-0.25 (1.19)		-0.015 (0.013)		-0.42^{b} (0.17)		0.0026 (0.0130)		0.56 (0.41)
K		-0.013^{c} (0.007)		-0.55 (0.62)		0.0071 (0.0073)		0.49^{a} (0.09)		-0.011 (0.007)		-0.43 (0.36)
Y		0.000049 (0.000073)		-0.0021 (0.0044)		0.000025 (0.000073)		0.0014^{c} (0.0008)		-0.000031 (0.000072)		0.00021 (0.00181)
FMG		0.13^{c} (0.07)		0.90 (3.82)		0.056 (0.070)		-0.33 (0.74)		0.051 (0.069)		0.65 (1.60)
SFMG		-0.0076^{b} (0.0030)		-0.320^{c} (0.1924)		-0.0076^{b} (0.0030)		0.1246^{a} (0.034)		-0.0084^{a} (0.0030)		-0.094 (0.099)
RPUB		-0.016^{b} (0.007)		0.70 (0.50)		-0.012^{c} (0.007)		0.034 (0.079)		-0.011 (0.007)		0.33 (0.19)
Constant	0.44 (--)	1.86 (--)	23.88 (--)	32.82 (--)	0.57 (--)	0.99 (--)	3.44 (--)	-31.75 (--)	0.33 (--)	1.87 (--)	10.89 (--)	8.69 (--)
R^2	0.03	0.08	0.18	0.20	0.03	0.08	0.16	0.34	0.06	0.10	0.05	0.10
	F(7,634) =2.7	F(18,623) =3.3	F(7,265) =8.3	F(18,254) =3.4	F(7,634) =3.6	F(18,623) =2.9	F(7,301) =8.0	F(18,290) =8.5	F(7,634) =5.5	F(18,623) =3.9	F(7,245) =1.8	F(18,234) =1.5

Notes:
a. Statistically significant at the 1 percent level.
b. Statistically significant at the 5 percent level.
c. Statistically significant at the 10 percent level.

It is plausible to expect that where the Federal Medical Assistance Percentage (K) is high, bureaucratic hassles are low. This proves to be the case for the percent of the time a claim is returned and for the time it takes to fill out claim forms, but not for delays in paying the physician. Per capita income demonstrates no effect. Physician attitudes, gauged by CON1 and CON2, only prove to be important in a couple of regressions.

Table D-5 presents administrative burden regressions for Blue Shield. Here the explanatory variables of greatest interest encompass Blue Shield characteristics. Patterns with regard to the included physician control variables are quite unclear. Although signs on the BD49 variables tend to be negative, implying that this type of program is less of a burden on the individual practicing physician; however, signs on BD51 tend to be positive, implying that plans in which physicians have the greatest voice pose a greater burden on individual physicians. Likewise, the Blue Shield market share variable varies in sign. Four of the six regressions have R^2s of 0.10 or less.

IMPLICATIONS

We have been far less successful in explaining variations in administrative burdens than we have variations in payment levels for specific procedures. Typically, there are two reasons for lack of success in multivariate analysis. First, our specification may be inadequate. The theories of administrative behavior are not very well developed and there may be much more to be learned about the internal workings of Medicaid programs that is of an institutional nature. Second, the data may be inadequate. It is quite possible that the responses one is able to obtain from physicians (and/or their aides) contain

Table D-5: Administrative Burden Regressions: Blue Shield

Explanatory Variables	Claim Most Likely to be Returned for Additional Work: Probability Blue Shield Mentioned	Percent of Time Claim Returned for Additional Work	Longest Payment Delays: Probability Blue Shield Mentioned	Months it Takes to be Paid	Claim Takes Longest To Fill Out: Probability Blue Shield Mentioned	Minutes it Takes to Fill Out Form
BD49	-0.12^b (0.06)	-4.95^c (2.68)	-0.057 (0.006)	0.18 (0.35)	-0.059 (0.058)	-3.93^c (2.38)
BD51	-0.002 (0.005)	1.33 (2.04)	0.040 (0.053)	0.34 (0.24)	0.024 (0.049)	0.29 (1.74)
BDSP	-0.17^c (0.09)	0.55 (3.96)	-0.21^b (0.09)	-1.95 (1.35)	-0.18^b (0.08)	0.67 (3.72)
MSOC	0.079 (0.124)	-9.30 (5.69)	-0.45^a (0.14)	-1.15^c (0.61)	0.13 (0.11)	-5.84 (4.69)
Y	0.000071 (0.000044)	0.0025 (0.0017)	0.00014^a (0.00004)	-0.00032 (0.00023)	0.000072^c (0.000040)	0.0011 (0.0014)
W	-0.14^b (0.07)	6.29 (4.74)	0.15^b (0.07)	0.60 (0.38)	-0.14^b (0.07)	11.57^a (3.34)
UN	-0.0044 (0.0031)	-0.044 (0.121)	0.00047 (0.00315)	-0.014 (0.015)	-0.0016 (0.0028)	-0.039 (0.112)
CBCERT	0.0031 (0.0024)	0.10 (0.11)	0.0029 (0.0026)	0.073^b (0.030)	-0.0025 (0.0022)	-0.034 (0.093)
CFMG	0.0074^c (0.0038)	-0.13 (0.19)	-0.0039 (0.0040)	0.076^c (0.045)	0.0060^c (0.0035)	-0.48^a (0.15)
CAGE	-0.0025 (0.0021)	-0.047 (0.102)	0.00089 (0.002129)	0.032 (0.022)	-0.0038^b (0.0020)	0.13 (0.09)
SPEC	-0.027 (0.049)	-1.40 (2.04)	0.0031 (0.0529)	0.13 (0.26)	-0.024 (0.045)	-5.17^a (1.71)
BCERT	0.039 (0.049)	-1.25 (1.94)	-0.038 (0.051)	0.11 (0.24)	0.027 (0.045)	-0.39 (1.58)
FAC	0.058 (0.072)	-1.52 (2.75)	0.12 (0.07)	-0.29 (0.30)	0.13^b (0.07)	-0.75 (2.16)
FMG	-0.060 (0.069)	0.16 (2.79)	-0.046 (0.070)	0.43 (0.33)	-0.094 (0.063)	2.74 (2.59)
AGE	-0.065 (0.045)	-1.36 (1.95)	0.016 (0.046)	0.21 (0.23)	-0.030 (0.042)	2.27 (1.65)
BSMS	0.0053^a (0.0015)	0.010 (0.073)	-0.00077 (0.00158)	-0.043^a (0.015)	0.0019 (0.0014)	0.057 (0.050)
Constant	0.38 (--)	-19.11 (--)	-0.62 (--)	-0.95 (--)	0.49 (--)	-29.52 (--)
R^2	0.09	0.08	0.10	0.21	0.05	0.20
	F(16,615) =3.9	F(16,214) =1.1	F(16,487) =3.3	F(16,127) =2.1	F(16,615) =2.0	F(16,148) =2.4

Notes: a. Statistically significant at the 1 percent level.
b. Statistically significant at the 5 percent level.
c. Statistically significant at the 10 percent level.

an important subjective element. If one is to gain an understanding of administrative burdens imposed by third parties on physicians, it probably will be necessary to conduct careful audits. An interview survey simply will not do.

APPENDIX E

Hospital-Based Physicians and the Medicare Economic Index

Bruce Steinwald

Introduction

The Social Security Amendments of 1972 (P.L. 92-603) contain a provision that mandates the use of an "economic index" to set ceilings on the allowable increases in prevailing fees of physicians that may be deemed reasonable for reimbursement purposes under Part B of Medicare.[1] To quote from a Senate report accompanying this Act,

> The (Senate Finance) committee, as well as the Committee on Ways and Means, believes that it is necessary to move in the direction of an approach to reasonable charge reimbursement that ties recognition of fee increases to appropriate economic indexes so that the program will not merely recognize whatever increases in charges are established in a locality but would limit recognition of charge increases to rates that economic data indicate would be fair to all concerned and follow rather than lead any inflationary trends. . .. The new ceiling on recognition of increases in prevailing charge limits that is provided would come into play only when the adjustments necessary to meet increases in the actual charges prevailing in a locality exceeded, in the aggregate, the level of increase justified by other changes in the economy. (U.S. Senate, 1972).

The "other changes in the economy" referred to above consist of changes in costs of doing business and in workers' earnings. The index is constructed so as to reflect physicians' expenditures on both real inputs (office space, clerical workers, and so forth) and their own time in producing medical services. The limits on reasonable charges are increased annually by a maximum amount dictated by the increase in the index. The index is also affected by worker productivity; if productivity increases, the earnings portion of the index is reduced proportionately.[2]

Implementation of the index for control of inflation in physicians' fees generally poses some problems, the major one of which is that it requires substantial data on the components of physicians practice costs and productivity. Indeed, this requirement is the motivating force behind the HCFA-NORC surveys.[3]

However, the Senate Finance Committee did not deem it necessary that the lack of detailed physician-specific data should delay implementation of the index concept. Accordingly, the index was first constructed with data available from Bureau of Labor Statistics surveys on economy-wide and health care industry-specific increases in costs, productivity, and earnings. The index was first implemented in fiscal 1976 (based on 1973-74 data on changes in index components). Data from the HCFA-NORC surveys were first introduced into the index in fiscal 1978. According to federal projections, application of the economic index caused a 1.8 percent decrease in Medicare-Part B charges per enrollee in fiscal 1978 (U.S. Department of Health, Education, and Welfare, 1979).

This appendix considers some of the special problems posed by the necessity of applying the economic index to fees charged by hospital-based physicians (HBPs).[4] The discussion is non-technical--it excludes detailed examinations of index construction and specific elements of the economic index. Instead, it focuses on differences between office-based and hospital-based physicians and how these differences may create problems for applying the economic index to fees charged by HBPs. These problems are enumerated and briefly discussed in the second section and concluding remarks are contained in the third and final section.

Before turning to discussion of specific problems of applying the economic index to HBP practices, it may be useful to compare relevant practice characteristics of HBPs and office-based MDs. Such comparisons, presented in Table E-1, highlight differences between these types of physicians. Differences apparent in the table are:

- The proportions of HBPs compensated on a fee-for-service basis are considerably lower than the corresponding proportion for office-based MDs.

- Of the three HBP specialties considered in Table E-1, pathologists have the lowest proportion compensated via fee-for-service (40%), followed by radiologists (67%) and anesthesiologists (78%).

Table E-1: Selected Practice Characteristics of Hospital-Based and Office-Based Physicians, 1976-78

	Anesthesiologists	Pathologists	Radiologists	Office-Based Physicians
Percent on Fee-for-Service Compensation, 1977-78	78%	40%	67%	about 95%
Mean Net Income of Fee-for-Service MDs, 1976-77[a]	$65,000	$75,000	$78,000	$59,000
Ratio of Net to Gross Income for Fee-for-Service MDs, 1976-77[a]	0.65	0.72	0.66	0.56
Mean Percentage of Patients with Medicare-Part B Coverage, 1977	28%	27%	28%	26%
Mean Proportion of Usual Fee Covered by Medi-Care-Part B, 1977:				
·Anesthesia for 30-min. tonsillectomy	0.70	--	--	--
·Anesthesia for 1-hr. cholecystectomy	0.72	--	--	--
·Urinalysis	--	0.84	--	--
·Complete Blood Count	--	0.82	--	--
·Operative Consult w/ Frozen Section	--	0.86	--	--
·Chest x-ray (single view)	--	--	0.80	--
·Upper G.I.	--	--	0.81	--
·Radiation Treatment/ Malignant Lesion	--	--	0.81	--
·Follow-up office visit	--	--	--	0.76
·Surgical Hernia Repair	--	--	--	0.75

---

a. Excludes deferred income (pension plan, etc.).

Source: HCFA-NORC surveys of Physician Practice Costs and Income, 1977 & 1978.

- HBPs compensated via fee-for-service have substantially higher net incomes than office-based MDs. Radiology is the most lucrative of the three HBP specialties followed by pathology and anesthesiology. If deferred income (pension plans, for example) and hours of work are also considered, the differences in incomes between HBPs and office-based MDs is even more pronounced.[5]

- The ratio of net to gross income is lower for HBPs than office-based MDs. Considering that the practices of HBPs tend to be capital-intensive, this means that much of the cost of HBPs practice inputs is subsidized by hospitals and clinics.

- The ratio of payments by Medicare - Part B to physicians' usual fees is higher for pathologists and radiologists than for anesthesiologists and office-based MDs. Proportions of patients with Medicare - Part B coverage are roughly the same, however.

Table E-1 presents only a few of the differences between office-based and hospital-based MDs. The potential significance of these and other differences is discussed in the next section.

Potential Problems of Applying the Economic Index to HBP Practices

HCFA program administrators are surely much more aware than the researcher of practical problems of implementing such programs as the Medicare economic index. Administrative actions that have received recognition in the public domain indicate that compensation of hospital-based physicians has been a source of difficulty for Medicare program implementation since the mid-1960s. These difficulties appear to be largely due to structural incompatibilities between HBP practice organization and Medicare reimbursement principles.[6] To a large extent, the potential problems listed below are related to these same difficulties. However, it should be recognized that the ensuing discussion is conjectural; it is not based on specific evidence of experience to date in applying the economic index to fees charged by HBPs. Potential problems are therefore listed and discussed with respect to perceived structural differences between HBP and office-based MD practices.

1. HBP practice input expenses are heavily subsidized by hospitals and clinics -- allowable increases in prevailing fees depend, in part, on costs of practice inputs. Because the index as it is presently constructed does not recognize differences between office-based MDs and HBPs in regard to the extent of input expense incurred, it gives too much weight to increases in input prices in the calculation of allowable prevailing fee increases for HBP practices. In recent years this has probably been to the HBPs' benefit, since input prices have generally been increasing at a faster pace than earnings.

2. The extent of input subsidy in HBP practices varies with HBP compensation and contractual arrangements with hospitals and clinics and such subsidies are subject to manipulation -- at one extreme is the lease arrangement, not very common, but one in which the HBP practice pays for virtually all inputs. These HBPs are similar in this respect to most office-based MDs (although some office-based MDs certainly have input subsidies also). At the other extreme are HBPs whose practice inputs are almost entirely subsidized. At present, the economic index does not recognize such differences. Under circumstances where HBP fees are being constrained by the economic index, hospitals and HBPs may have an incentive to jointly maximize revenue -- the hospital may assume a larger share of HBP practice expenses in return for a *quid pro quo* (possibly a larger slice of the ancillary service revenue pie). Such practices would tend to undermine the intent of the economic index even if HBP fee screens are effective.

3. HBP outputs and charging systems are subject to "unpackaging" and "repackaging" phenomena -- It has been noted in the past (see Sloan and Steinwald, 1975, for example) that one type of physician response to third-party restrictions on payment for physicians' services is to engage in à la carte billing or redefining services in such a way as to avoid restrictions. HBP practices,

especially pathology, may be particularly susceptible to this type of activity. First, services tend to be produced in relatively small units, but often several services (e.g., different lab tests) are performed on a single patient encounter. Second, ancillary services provided by HBPs are more sensitive to technology advances than most other forms of of medical practice. As new procedures enter the spectrum of services provided by HBPs, and often are combined with existing procedures in the same "package," Medicare fee screens must establish new customary and prevailing fees. This difficulty may be exacerbated by implementation of the Medicare economic index.

Conclusion

That hospital-based physicians are different in significant ways from office-based physicians there can be no doubt. Structural differences between office-based and hospital-based medical practice may, in part, account for higher incomes of HBPs, and (possibly, but pure conjecture) for the fact that radiologists and pathologists, on average, receive a higher proportion of their usual fees from Medicare Part B than do office-based MDs. The problems listed in the previous section may create difficulties for applying the Medicare economic index to HBPs, but it does not necessarily follow that the index should be suspended or modified for fees for HBP services. The benefits of such a decision should be weighted against its costs, which may be substantial.

First, the difficulties listed above are matters of degree, not absolutes. That is, many physicians in office-based specialties receive variable subsidies of practice expenses from hospitals and clinics, and the problems of unpackaging and repackaging, among others, also are industry-wide. Assuming that such problems are more severe in hospital-based specialties, it may be possible to modify the index for these specialties -- for example, to use a recalculated factor for input expenses when determining allowable increases in prevailing fees.

But at what cost? To make such calculations separately for each physician would be at best an administrative nightmare and probably impossible with current data availability. Attempting to place HBPs in a single group would ignore difference among HBP specialties and would encounter definitional problems if this effort attempted to include more than the traditional HBP specialties. And, of course, the reaction of the medical community must also be considered (perhaps foremost) Finally, HBPs are not so much different from office-based MDs to make it likely that tailoring the economic index to HBP practices would be worth the added costs.

One of the most appealing aspects of the economic index as a cost-saving device (to taxpayers) is its relative simplicity. Application of the index may work less well in HBPs than other MDs and there may be more opportunities for circumvention in HBP specialties. As stated earlier, the problems cited above are largely conjectural, but the costs of remediation would be substantial. HCF feels (with supporting evidence) that it is saving substantial amounts of money, on average, by applying a single economic index to fees charged by all physician to Medicare patients. Perhaps it is best to leave well enough alone.

Footnotes to Appendix E

[1] Reimbursements to physicians under Part B of Medicare are made on the basis of "customary-prevailing-reasonable" criteria. A physician's fee meets the customary criterion if it does not exceed his/her modal fee for a specified period of time, and the prevailing criterion is met if the fee does not exceed the 75th percentile of fees charged for the same procedure by other physicians in a locality. If both these criteria are met, or if a higher fee can be justified on the basis of unusual circumstances, the fee is deemed reasonable.

[2] See Berry (1980) for details on construction of the Medicare economic index.

[3] Physician surveys sponsored by the Health Care Financing Administration (HCFA) and performed by the National Opinion Research Center (NORC) were initiated in 1976 in response to a perceived need for more thorough and regular data on physicians' practices than are available from other sources. In 1977, the survey was broadened to include representation of a variety of medical specialties. This included development of a modified instrument to accommodate the special characteristics of HBPs in anesthesiology, pathology, and radiology. The HCFA-NORC surveys use telephone interviews of physicians and their employees as the primary data collection technique. The 1977 survey yielded 3,482 completed questionnaires from office-based MDs and 543 from HBPs (208 anesthesiologists, 115 pathologists, and 220 radiologists). The overall response rate was 70 percent.

[4] The discussion applies primarily to pathologists and radiologists and, to a lesser extent, to anesthesiologists . The vast majority of anesthesiologists are practitioners who bill their patients directly. Some points may also apply to other types of HBPs, including cardiologists and emergency room specialists.

[5] See Steinwald (1980) for more details on HBP practice characteristics and for information on trends in HBP compensation.

[6] The relationship between Medicare and compensation for HBP sources is discussed in Steinwald (1980).

Appendix F

Logit Regressions for Generating Probabilities of HBP Compensation Methods

Bruce Steinwald

Logit Regressions for Generating Probabilities of HBP Compensation Methods (Chapter 10)

By definition, there are three distinct methods by which HBPs receive compensation in the empirical models specified in Chapter 10: P_1 represents the probability of salaried compensation; P_2 represents the probability of percentage of department revenue compensation; and P_3 represents the probability of fee-for-service compensation. The three compensation methods are defined in the text. Let X_i represent a vector of characteristics of HBPs (or communities where they practice) that are hypothesized to influence choice of compensation method. The probability that the i^{th} compensation method is selected is represented by:

$$P_i = e^{\alpha'_i x} / \sum_{m=1}^{n} e^{\alpha'_m x} \qquad \text{(F-1)}$$

Given a similar expression for $P_j (i \neq j)$, and taking natural logarithms, the relationship between P_i and P_j is represented by:

$$\ln(P_i/P_j) = (\alpha_{i0} - \alpha_{j0}) + (\alpha_{i1} - \alpha_{j1})X_1 + (\alpha_{i2} - \alpha_{j2})X_2 \; . \; . \; . \; . \qquad \text{(F-2)}$$

Because there are three probabilities to be calculated, two logit functions are estimated for each of the three HBP specialties. A chi-square test with n - 1 degrees of freedom (n = number of observations in the regression) is used to test the null hypothesis that a specific explanatory variable (X_i) makes no contribution to choice of compensation method. The overall test of significance of the logit regression is also chi-square with 2X(number of explanatory variables) degrees of freedom. From the parameter estimates of the logit regressions, estimated probabilities of salaried compensation (P_1) and percentage compensation

(P_2) can be calculated. Since $P_3 = 1 - P_1 - P_2$, the probability of fee-for-service compensation can easily be derived. Predicted probabilities for each HBP are entered as independent variables in Chapter 10's income, expense, and output regressions.

Logit regression results for the three HBP specialties are presented in Tables F-1, F-2, and F-3. Independent variables representing HBPs' personal, professional, and market characteristics are defined as in Chapter 10. All other variables are dummy variables which take the value 1 if the HBP (or his/her location) has the attribute indicated by the variable name, and the value 0 otherwise. The variable TIME is 1 if the data year is 1977 and 0 if the data year is 1976. Location in the North Central census region is indicated by REG2, South by REG3, and West by REG4. The Northeast census region is the omitted category. Location in a Standard Metropolitan Statistical Area (SMSA) of 50,000 to 1,000,000 population is represented by SMSA2 and location in a SMSA of more than 1,000,000 population is represented by SMSA3. Non-SMSA and potential SMSA areas constitute the omitted category.

Parameter estimates in Tables F-1 through F-3 should be interpreted in the following manner. The first column of estimates indicates the contribution of the variable to choice of salaried compensation relative to fee-for-service. The second column indicates the contribution to choice of percentage compensation relative to fee-for-service. Relative contributions to choice of salary versus percentage compensation can be inferred from each pair of estimates. Thus, for example, in all three specialties, FMGs are more likely, relative to non-FMGs, to choose salaried compensation than either fee-for-service or percentage compensation, _ceteris paribus_. FMGs are relatively more likely to choose fee-for-service over percentage compensation in anesthesiology and pathology but not in radiology.

Very few substantive findings can be inferred from the logit regressions. Few of the parameter estimates attain statistical significance at conventional levels and the majority are unstable across specialties. The only strong and consistent result is that, for all three specialties, location in the Northeast makes salaried compensation relatively more likely. All three regression chi-square statistics are significant at the one percent level. Judging from the chi-square levels, the logit regressions for pathologists (Table F-2) and radiologists (Table F-3) perform better than the regression for anesthesiologists (Table F-1). This is probably due to the fact that fee-for-service compensation dominates anesthesiology to such an extent that there is relatively little variation in choice of compensation method for the regression estimates to explain.

Table F-1. Logit Regression for Compensation Method of Anesthesiologists

Variable	*ln(P_1/P_3)*	*ln(P_2/P_3)*	*chi-square (2 d.f.)*
BOARD	-0.318	-0.232	0.44
FMG	0.482	-0.123	1.58
AGE65	-0.367	-0.109	0.50
GRAD10	1.395	-0.171	3.05
PERCAP	0.00058	0.00049	8.29[b]
OMDPOP	-0.042	0.495	3.34
HMDPOP	7.656	-16.090	3.75
TIME	-0.396	-0.455	1.24
REG2	-1.814	-0.261	12.36[a]
REG3	-1.767	-0.766	10.20[a]
REG4	-13.239	-0.492	0.49
SMSA2	0.695	0.441	1.52
SMSA3	0.522	-0.399	1.01
Constant	-5.087	-4.492	--

chi-square (26 d.f.) = 66.05[a]

Notes: P_1 = probability of salaried compensation; P_2 = probability of percentage of department revenue compensation; P_3 = probability of fee-for-service compensation.

a = significant at the 1% level; b = significant at the 5% level; c = significant at the 10% level.

Table F-2. Logit Regression
for Compensation Method of Pathologists

Variable	$\ln(P_1/P_3)$	$\ln(P_2/P_3)$	*chi-square (2 d.f.)*
BOARD	-0.977	-0.857	4.66[c]
FMG	0.395	-0.544	4.43
AGE60	0.226	-0.777	2.52
GRAD10	0.575	-0.165	1.57
PERCAP	-0.00017	0.00014	1.72
OMDPOP	0.210	-0.422	2.21
HMDPOP	-6.277	5.120	1.14
TIME	-0.296	-0.324	1.45
REG2	-1.768	0.345	21.89[a]
REG3	-2.193	-0.471	25.20[a]
REG4	-2.158	-0.359	20.36[a]
SMSA2	0.256	-0.115	0.81
SMSA3	0.347	-0.213	1.05
Constant	3.208	-0.857	--
		chi-square (26 d.f.) = 90.69[a]	

Notes: P_1 = probability of salaried compensation; P_2 = probability of percentage of department revenue compensation; P_3 = probability of fee-for-service compensation.

a = significant at the 1% level; b = significant at the 5% level; c = significant at the 10% level.

Table F-3. Logit Regression
for Compensation Method of Radiologists

Variable	*$\ln(P_1/P_3)$*	*$\ln(P_2/P_3)$*	*chi-square (2 d.f.)*
BOARD	-0.250	0.275	0.66
FMG	1.868	0.306	15.93[a]
AGE60	0.790	0.456	2.69
GRAD10	1.377	0.301	7.77[b]
PERCAP	0.00019	0.00030	4.48
OMDPOP	0.649	0.161	2.62
HMDPOP	-12.096	-3.010	1.94
TIME	0.334	-0.909	10.06[a]
REG2	-1.791	0.294	10.22[a]
REG3	-0.914	0.723	6.58[b]
REG4	-1.759	0.254	8.23[b]
SMSA2	-0.538	-0.065	1.24
SMSA3	-1.324	-0.091	4.74[c]
Constant	-1.962	0.368	--
		chi-square (26 d.f.) = 87.03[a]	

Notes: P_1 = probability of salaried compensation; P_2 = probability of percentage of department revenue compensation; P_3 = probability of fee-for-service compensation.

a = significant at the 1% level; b = significant at the 5% level; c = significant at the 10% level.

Appendix G

Derivations for Chapters 12 and 13

George Sweeney

A. Calculation of the term s_i of equation (12-12d):

By definition:

(a1) $$f^1(z,\mu,\sigma^2) = (2\pi\sigma^2)^{\frac{1}{2}} \quad \exp[-\frac{1}{2\sigma^2}(z-\mu)^2]$$

Substituting this expression into equation (12d) implies:

(a2) $$s_i = (2\pi\sigma_\varepsilon{}^2)^{-w_i/2} \exp\left\{-\frac{1}{2\sigma_\varepsilon{}^2}\sum_{j=1}^{w_i}[R_{ij} - \tilde{t}'\tilde{y}_{ij}]^2\right\}$$

B. Calculation of the term r_i defined by equation (12-12b):

Let Z represent an n dimensional normally distributed random vector, let μ represent its mean vector, and let V represent its covariance matrix. The joint density of Z is represented by the following expression..

(a3) $$f^n(Z,\mu,V) = (2\pi)^{-n/2}\,|V|^{-\frac{1}{2}} \quad \exp\{-\frac{1}{2}(Z-\mu)'V^{-1}(Z-\mu)\}$$

Let $\tilde{R}_i$ represent the vector of dimension w_i which represents the incomes of the w_i firms observed in the i^{th} market. Let $\tilde{J}$ represent the vector of dimension w_i with all elements equal to 1. Substituting this expression into equation (12b) implies:

(a4) $$r_i = (2\pi)^{-w_i/2}|\Sigma_i|^{-\frac{1}{2}} \exp\left\{-\frac{1}{2}\left(\tilde{R}_i - \frac{n_i\tilde{m}'\tilde{x}_i}{d_i}\tilde{J}\right)'\Sigma_i{}^{-1}\left(\tilde{R}_i - \frac{n_i\tilde{m}'\tilde{x}_i}{d_i}\tilde{J}\right)\right\}$$

the remainder of this section will prove the following result:

(a5) $$r_i = (2\pi)^{-w_i/2}(\sigma_\theta{}^2)^{-w_i/2}(1+w_i/\rho_i)^{-\frac{1}{2}}\exp(-\tfrac{1}{2}d_ie_i)$$

where:

(a6) $$\rho_i = \frac{1}{n_i/d_i^2} \frac{\sigma_\theta^2}{\sigma_\mu^2}$$

(a7) $$d_i \equiv \frac{1}{\sigma_\theta^2 (w_i + \rho_i)}$$

(a8) $$e_i \equiv (w_i + \rho_i) \sum_{j=1}^{w_i} \left[R_{ij} - \frac{n_i \tilde{m}' \tilde{x}_i}{d_i} \right]^2 - \left[\sum_{j=1}^{w_i} [R_{ij} - \frac{n_i \tilde{m}' \tilde{x}_i}{d_i}] \right]^2$$

In this proof, the subscript i will be omitted from all variables to facilitate notation.

Let A represent a square matrix of dimension w, the diagonal elements of which equal $1 + \rho$ and the off-diagonal elements of which equal 1. By definition (12e), $\Sigma = (\sigma_\mu^2 \, n/d^2)A$. Therefore:

(a9) $$\Sigma^{-1} = \left[\frac{1}{n/d^2} \right] \left[\frac{1}{\sigma_\mu^2} \right] A^{-1}$$

(a10) $$|\Sigma| = \left[\frac{n}{d^2} \sigma_\mu^2 \right]^w |A|$$

lemma 1

A^{-1} equals the product of the scalar $1/[\rho(w+\rho)]$ with a symmetric matrix the diagonal elements of which equal $w + \rho - 1$ and the off-diagonal elements of which equal -1.

proof:

Let B represent a matrix the diagonal elements of which equal $w+\rho-1$ and the off-diagonal elements of which equal -1. That is, $B \equiv \rho(w+\rho)A^{-1}$. Let L represent the product of the two matrices A and B: $L \equiv AB$.

Consider the i,j^{th} element of L:

$$L_{ij} = \sum_{k=1}^{w} A_{ik}B_{kj} \tag{a11}$$

(1) Suppose that $i \neq j$. Then: $A_{ii}B_{ij} = -(1+\rho)$, $A_{ij}B_{jj} = w+\rho-1$, and $A_{ik}B_{kj} = -1$ for $k \neq i$; $k \neq j$. Therefore: $L_{ij} = -(1+\rho) + (w+\rho-1) + (-1)(w-2) = 0$ for $i \neq j$.

(2) Suppose that $i = j$. Then: $A_{ii}B_{ii} = (1+\rho)(w+\rho-1)$ and $A_{ik}B_{ji} = -1$ for $k \neq i$. Therefore: $L_{ij} = (1+\rho)(w+\rho-1) + (-1)(w-1) = \rho(w+\rho)$ for $i = j$. Thus: $AB = \rho(w+\rho)I$. Q.E.D.

lemma 2

$$|A| = (\rho+w)\rho^{w-1}$$

proof:

det(A) is a special form of a "circulant." In general, a circulant is the determinant of a w dimensional matrix M which has the following form.

$$M = \begin{bmatrix} m_1 & m_2 & \cdot & \cdot & \cdot & \cdot & m_w \\ m_w & m_1 & m_2 & \cdot & \cdot & \cdot & m_{w-1} \\ m_{w-1} & m_w & m_1 & m_2 & \cdot & \cdot & m_{w-2} \\ \cdot & & & \cdot & & & \cdot \\ \cdot & & & & \cdot & & \cdot \\ \cdot & & & & & \cdot & \cdot \\ m_2 & & & \cdot & \cdot & m_w & m_1 \end{bmatrix} \tag{a12}$$

The circulant, or determinant of M, can be calculated from the following expression (Laenas Weld).

$$|M| = \prod_{k=0}^{w} Z_k \tag{a13}$$

where:

$$Z_k \equiv \sum_{j=1}^{w} m_j r_k^{j-1} \tag{a14}$$

and

$$r_k \equiv \exp\left(\frac{2\pi k}{w} i\right) \tag{a15}$$

$$i \equiv \sqrt{-1}$$

That is, the r_k's represent the w distinct roots of the equation; $x^w - 1 = 0$.

For the matrix A:

$$m_1 = 1 + \rho; \quad m_j = 1 \text{ for } j = 2, 3, \ldots, w \tag{a16}$$

Substituting equations (a16) into equations (a14) and (a15), the following equations can be derived.

(a17) $$Z_0 = (1+\rho) + \sum_{j=2}^{w} (1) = \rho + w$$

(a18) $$Z_k = (1+\rho) + \sum_{j=2}^{w} [\exp(\frac{2\pi k}{w} i)]^{j-1} \qquad \text{for } k = 1, \ldots, w-1$$

Let: $\theta_k \equiv \exp(\frac{2\pi k}{w} i)$

Then:

$$\sum_{j=2}^{w} \theta_k^{j-1} = \sum_{j=1}^{w-1} \theta_k^{j} = \frac{1-(\theta_k)^w}{1-\theta_k} - 1$$

But:

$$(\theta_k)^w = \exp 2\pi ki = \cos(2\pi k) + i \sin(2\pi k) = 1$$

Thus, (since $1-\theta_k \neq 0$ for $k = 1, 2, \ldots, w-1$):

$$\sum_{j=2}^{w} \theta_k^{j-1} = -1 \qquad k = 1, 2, \ldots, w-1$$

Therefore, equation (a18) implies:

(a19) $$Z_k = \rho \qquad k = 1, 2, \ldots, w-1$$

Equations (a13), (a17), and (a19) imply:

(a20) $$|A| = (\rho + w)\rho^{w-1}$$

Q.E.D.

Equations (a9), (a10) and lemmas (1) and (2) imply:

(a21) $$|\Sigma_i| = (\sigma_\theta^2)^{w_i} (1 + w_i/\rho_i)$$

(a22) $$\Sigma_i^{-1} = \frac{1}{\sigma_\theta^2(w_i+\rho_i)} \begin{bmatrix} w_i+\rho_i-1 & & -1 \\ & \ddots & \\ -1 & & w_i+\rho_i-1 \end{bmatrix}$$

Equations (a21) and (a22), together with equation (a4), imply equations (a5) - (a8).

Derivatives of Inverse Demand Function (Chapter 13):

(A1.1) $F(Q, X, Y, I, A, \tilde{R}) = [1 + h(Y)][f_o(Q/R) + g(I) + r(X)]$

where $R \equiv \tilde{R}a(A)$:

(A1.2) $F_Q = \frac{1}{R}(1 + h)f_o'$

(A1.3) $F_X = (1 + h)r'$

(A1.4) $F_Y = h'[f_o + g + r]$

(A1.5) $F_I = (1 + h)g'$

(A1.6) $F_R = -(1 + h)\frac{Q}{R^2}f_o'$

(A1.7) $F_{QQ} = \frac{1 + h}{R^2}f_o''$

(A1.8) $F_{QX} = 0$

(A1.9) $F_{QY} = \frac{h'}{R}f_o'$

(A1.10) $F_{QI} = 0$

(A1.11) $F_{QR} = \frac{-1}{R^2}(1 + h)[f_o' + \frac{Q}{R}f_o'']$

(A1.12) $F_{XX} = (1 + h)r''$

(A1.13) $F_{XY} = h'r'$

(A1.14) $F_{XI} = 0$

(A1.15) $F_{XR} = 0$

Relationships between Demand Function and Its Inverse (Chapter 13):

Let $D(P, X, E)$ be demand function

$F(Q, X, E)$ be inverse demand function

Then:

(A2.1) $F_Q = \frac{1}{D_P}$

(A2.2) $F_X = -\frac{D_X}{D_P}$

(A2.3) $F_E = -\frac{D_E}{D_P}$

(A2.4) $F_{QQ} = \frac{-D_{PP}}{D_P{}^3}$

(A2.5) $F_{QX} = \frac{D_X D_{PP} - D_P D_{PX}}{D_P{}^3}$

(A2.6) $F_{XX} = \frac{D_P{}^2 D_{XX} - D_X D_P D_{PX} + D_X{}^2 D_{PP}}{-D_P{}^3}$

(A2.7) $D_P = \frac{1}{F_Q}$

(A2.8) $D_X = -\frac{F_X}{F_Q}$

(A2.9) $D_E = -\frac{F_E}{F_Q}$

(A2.10) $D_{PX} = \frac{F_X F_{QQ} - F_Q F_{QX}}{F_Q{}^3}$

Appendix H

Derivations for Chapter 15

Harris Schlesinger

Risk Aversion and Insurance

It was claimed in Proposition 1 that the more risk averse the physician, the higher the liability limit on his optimal insurance contract. Although this result is not new to insurance literature, a proof is presented below for the present model.

Lemma: Let $r(Y) = -U''(Y)/U'(Y)$ denote the Arrow-Pratt measure of absolute risk aversion. Then $\tilde{U}$ is uniformly more risk averse than U in the sense that $\tilde{r}(Y) \geq r(Y)$ for all Y, if and only if, for any liability limit, z, and any care level, x

$$\frac{\int_z^\infty \tilde{U}'(R(x) - C(x) - \pi z + z - M)f(M)dM}{E\tilde{U}'} \geq$$

$$\frac{\int_z^\infty U'(R(x) - C(x) - \pi z + z - M)f(M)dM}{EU'} .$$

Proof of the lemma: Let $\tilde{r}(Y) \geq r(Y)$.

Then $\frac{\tilde{U}''(Y)}{\tilde{U}'(Y)} \geq -\frac{U''(Y)}{U'(Y)}$

or equivalently $\frac{d}{dY} \log \tilde{U}'(Y) \leq \frac{d}{dY} \log U'(Y)$.

Integrate from $Y = R(x) - C(x) - \pi z + z - M$ to $Y = R(x) - C(x) - \pi z$ for any x, z and for $M \geq z$ to obtain

$$\log U'(K) - \log U'(K + z - M) \leq \log U'(K) - \log U\ (K + z - M)$$

where $K = R(x) - C(x) - \pi z$.

This is equivalent to

$$\log \frac{\tilde{U}'(K)}{\tilde{U}'(K + z - M)} \leq \log \frac{U'(K)}{U'(K + z - M)}.$$

Consequently

$$\frac{\tilde{U}'(K)}{\tilde{U}'(K + z - M)} \leq \frac{U'(K)}{U'(K + z - M)}.$$

Multiplying both sides of this expression by $[p + \int_o^z f(M)dM]$,

$$\frac{[p + \int_o^z f(M)dM]\tilde{U}'(K)}{\tilde{U}'(K + z - M)} \leq \frac{[p + \int_o^z f(M)dM]U'(K)}{U'(K + z - M)} .$$

Invert both sides above, and take expectations conditional on $M \geq z$ to obtain

$$\frac{\int_z^\infty \tilde{U}'(K + z - M)f(M)dM}{[p + \int_o^z f(M)dM]\tilde{U}'(K)} \geq \frac{\int_z^\infty U'(K + z - M)f(M)dM}{[p + \int_o^z f(M)dM]U'(K)}$$

Reinverting and adding one to both sides

$$\frac{E\tilde{U}'}{\int_z^\infty U'(K + z - M)f(M)dM} \leq \frac{EU'}{\int_z^\infty U'(K + z - M)f(M)dM} .$$

This shows the "only if" part of the lemma. To prove that the "if" part holds, reverse all of the inequalities above and make them strict inequalities. This completes the proof.

By eqn (15-9) the ratio, $[\int_z^\infty U'(K + z - M)f(M)dM]/EU'$, must equal the price of insurance, π, at the physician's optimal liability limit. If the physician were to become more risk averse, this ratio would increase, indicating that the physician should purchase additional coverage.

Proof of Proposition 1: By the preceding lemma and eqn (15-9), an increase in the level of risk aversion implies that

$$\pi = \frac{\int_z^\infty U'(K + z - M)f(M)dM}{EU'} < \frac{\int_z^\infty \tilde{U}'(K + z - M)f(M)dM}{E\tilde{U}'}$$

Consequently, $\partial E\tilde{U}/\partial z = -\pi E\tilde{U}' + \int_z^\infty \tilde{U}'(K + z - M)f(M)dM > 0$. Therefore, a higher liability limit should be obtained under $\tilde{U}$.

Risk Aversion and Care

Proof of Proposition 2: First, consider a two-state model in which M is nonrandom. (The probability of a malpractice loss, M, is $(1 - p)$.) Rewrite the optimal care condition, (15-18), as

$$C'(x) - R'(x) = \frac{\frac{\partial p}{\partial x}[U(K) - U(K + z - M)]}{pU'(K) + (1 - p)U'(K + z - M)}$$

where again $K = R(x) - C(x) - \pi z.$

If the RHS above increases (decreases) then $\partial EU/\partial x > 0$ (<0) and more (less) care should be used.

Let $\tilde{U}$ be a more risk averse utility function than U. By Theorem 1 in Pratt (1964, pp. 128-129), this implies that

$$\frac{\tilde{U}(K) - \tilde{U}(K + z - M)}{\tilde{U}'(K)} > \frac{U(K) - U(K + z - M)}{U'(K)}$$

and

$$\frac{\tilde{U}(K) - \tilde{U}(K + z - M)}{\tilde{U}'(K + z - M)} < \frac{U(K) - U(K + z - M)}{U'(K + z - M)}.$$

Since $\partial p/\partial x > 0$, the proposition follows directly for a two-state model.

Noting that this is true regardless of the size of M (except for how near to 0 or 1 p needs to be in order to be "sufficiently near"), the proposition follows for the continuous-state model as well.

Proof of Proposition 3: If L is the supremum of malpractice losses, then $f(M) \equiv 0$ for $M > L$. Consequently

$$p + \int_0^L f(M)\,dM = 1.$$

If full coverage, $z = L$, is purchased then by eqn (15-8)

$$[C'(x) - R'(x)]\,EU' = [\frac{\partial p}{\partial x} + \int_0^z \frac{\partial f}{\partial x} dM]U(K)$$

but

$$\frac{\partial p}{\partial x} + \int_0^z \frac{\partial f}{\partial x} dM = 0.$$

Consequently, since $EU' > 0$, it follows that $R'(x) = C'(x)$. Similarly, it can be seen that if $z \to L_-$ then $x \to x^*$.

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